BULLETIN OF THE

TAYLOR SOCIETY

AN INTERNATIONAL SOCIETY TO PROMOTE THE SCIENCE
AND THE ART OF ADMINISTRATION AND OF MANAGEMENT

Critical Essays on
SCIENTIFIC MANAGEMENT
Being a Collection of Articles Inspired by Copley's Life of Frederick W. Taylor

Charles deFreminville
Irving Fisher
Oliver Sheldon
Ida M. Tarbell
and others

Engineering Societies Building
29 W. Thirty-Ninth St.
New York

FEBRUARY, 1925 VOL. X, NO. 1

PART II

Officers of the Taylor Society

President ....Percy S. Brown, Corona Typewriter Co., Inc., Groton, N. Y. (1925)
Vice-President ....Howard Coonley, Walworth Manufacturing Co., Boston, Mass. (1925)
Vice-President ....Henry P. Kendall, Kendall Mills, Inc., Boston, Mass. (1926)
Treasurer ....Edward W. Clark, 3d, E. W. Clark & Co., Philadelphia, Pa. (1925)
Managing Director ......Harlow S. Person, Taylor Society, 29 W. 39th St., New York.
Ass't Managing Director..Ruth Reticker, Taylor Society, 29 W. 39th St., New York.

Board of Directors

All the officers *ex-officio*, and

Mary Van Kleeck, Russell Sage Foundation, New York (1925)

William B. Ricketts, The Operadio Corporation, Chicago (1925)

Nathaniel G. Burleigh, Amos Tuck School of Dartmouth College, Hanover, N. H. (1926)

C. Leslie Barnum, New York (1926)

Past Presidents

James Mapes Dodge, Link-Belt Company, Philadelphia (deceased).

Harlow S. Person, Amos Tuck School, Hanover, N. H.

J. E. Otterson, Winchester Repeating Arms Co., New Haven, Conn.

Henry S. Dennison, Dennison Manufacturing Co., Framingham, Mass.

Richard A. Feiss, The Joseph & Feiss Co., Cleveland, Ohio.

Local Sections

New York

Chairman of Executive Committee: C. Leslie Barnum, 6 North Place, Pleasantville, N. Y.

Philadelphia

Secretary-Treasurer: R. H. Lansburgh, Wharton School, University of Pennsylvania.

Chicago

Secretary-Treasurer: Charles R. Simmons, Bruner & Simmons, Inc., 327 S. La Salle Street.

Cleveland

Secretary: Harry Kaiser, Cleveland Metal Products Co.

New England

Secretary-Treasurer: Henry H. Farquhar, Harvard Graduate School of Business Administration, Cambridge, Mass.

Central New York

Secretary-Treasurer: Robert J. Andersen, Bowen Products Corporation, Auburn, N. Y.

New York Southern Tier Counties

Secretary: Edgar D. Sebring, Corona Typewriter Company, Groton, N. Y.

FEB 25 1925

BULLETIN OF THE
TAYLOR SOCIETY
AN INTERNATIONAL SOCIETY TO PROMOTE THE SCIENCE
AND THE ART OF ADMINISTRATION AND OF MANAGEMENT

VOL. X, No. 1 FEBRUARY, 1925 PART II

Contents

Foreword 29
How Taylor Introduced the Scientific Method Into Management of the Shop 30
By Charles deFreminville
Scientific Management Made Clear . . 41
By Irving Fisher
Taylor's Intellectual Contribution . . 62
By Ordway Tead
An Authentic Genius 66
By Stuart Chase
Taylor the Creative Leader 69
By Oliver Sheldon
Making the Most of Men 80
By Ida M. Tarbell
A Hero of Industrial Progress . . . 81
By Allan Nevins
Taylor a Scientific Revolutionary . . 83
By Edward Eyre Hunt
An Appreciation of a Contemporary. . 84
By Fred J. Miller
Taylor the Cooperationist 86
By Richard A. Feiss
A Promoter of Harmony 88
By Scudder Klyce
Scientist of Work 88
By H. S. Person
"Take Nothing for Granted" 89
By Edward P. Leonard
Excerpts from other reviews . 61, 65, 79, 92
By L. P. Alford, Joseph H. Willits, Lillian M. Gilbreth, Paul Atkins and Alice Bradley.

Foreword

THERE was a time when an occasional new book inspired reviews which were essentially independent essays on the subject-matter of the book. That is now rarely the case. So relatively infrequent is the appearance of a work which makes noteworthy addition to existing knowledge that reviewing has become largely perfunctory. Rarely does there appear a book of such merit as to break through the barrier of present reviewing convention and inspire appraisal after the earlier manner.

COPLEY'S life of Frederick W. Taylor[1] is one of the exceptions. It has stimulated during the year since its publication a number of reviews in the nature of critical essays on scientific management. So informing are many of these essays, so various are the angles from which the life and work of Taylor are viewed, that taken together they constitute a valuable addition to the literature of scientific management. It seems to the Taylor Society so important that these essays be made available to students of management, that with the permission of various publishers they are brought together in this supplementary issue of the BULLETIN.

IT IS important that a book be readable. The reviewers are unanimous in their judgment that the story of the man's life and work is made as interesting as the story of any imaginary character in fiction. "Not since as a boy I read Robinson Crusoe have I been so thrilled by a story of adventure," says Irving Fisher. Yet all agree also that accuracy has not been sacrificed for interest; that throughout the work is abundant evidence of thorough investigation, and of painstaking and successful effort to picture the man as he was, why he was what he was, and why, being what he was, it was inevitable that he should do the work he did.

BUT the characteristic of the Taylor biography which has stimulated reviews in the nature of essays on scientific management is that it is the history of an epoch in American industrial history and of the origin and development of scientific management. Taylor's industrial career began about 1880, a date which marks the beginning of a second industrial revolution. That industrial revolution has not yet been adequately written up; therefore the life story of a man who lived through it, fought it, helped it and influenced it is an important historical document. As a treatise on management the biography is a genetic account of the origin and development of scientific management, more informing and more important than treatises which are but sets of generalizations, as most of the literature, including Taylor's own expositions, has been. The biography is a text-book on scientific management, and these review essays are valuable comments on the text-book.

---

[1] "Frederick W. Taylor, Father of Scientific Management," by Frank Barkley Copley. Harper and Brothers, New York, 1923. 2 Vols., $10.00; pp., Vol. I, xxvii, 467; Vol. II, 472.

658.
658.92

How Taylor Introduced the Scientific Method Into Management of the Shop

By **CHARLES DE FRÉMINVILLE**
Consulting Engineer, Schneider et Cie, Paris
Translated by ELEANOR BUSHNELL COOKE, Philadelphia

PUBLICATION of the Life of Frederick W. Taylor by Frank Barkley Copley is a notable event, as the book throws an entirely new light on the work of that extraordinary innovator by giving definite details of the manner of the development of scientific management. It is of especial importance to the French, who have been particularly alive to the significance of the movement inspired by Taylor.

Taylor himself has said that no concise definition can fully describe an art, and that the essence of modern scientific management is the application of certain broad, general principles which can be applied over a wide field. In order, therefore, to grasp the spirit of his principles it is necessary to apply oneself to a study of the facts presented by the story of his life, rather than to subject the manner in which he has expressed his principles to carping criticism or to interpret the words he used too literally.

It was about twenty years ago that the work of Taylor was called to the attention of French engineers by M. H. Le Chatelier in the *Revue de Métallurgie*. The impression produced was astonishing. It was realized that here was indeed the description of a work of unusual significance. It was no longer a question of counselling as to how better to utilize scientific knowledge in order to increase the efficiency of industrial operations or of following a scientific method in their investigation, such as had already been given in a more or less explicit manner. Taylor took the problem in hand and pursued it to its logical conclusion, working at the patternmaker's and machinist's trade in order to do so intelligently. He then called a halt on the old methods and formally indicted the existing industrial practices which tended towards an ineffective utilization of material and of labor, low production and lack of understanding between employer and employee.

Many became interested, including not only the manufacturers and technical men who were being particularly scrutinized, not to say criticized, but even the public at large who up to this time had not seemed to be much interested in industrial work. For after Taylor had charged the limited daily output with being the cause of enormous waste, everybody felt authorized to give advice, but how very few had the ability to do so intelligently!

Immediately a concert of critics developed. Taylor discovered that the output of the shop was not the whole story. It was not necessary to enlarge upon that subject. Everyone recognized the character of a modern shop and its methods, with the sovereignty of the machine, the repetitive work, the extreme specialization, the mechanical tendency and the monotony, the speeding up, the mental depression and exploitation of the worker. What else could a man anxious to increase the production of shop do, but push to the limit the development of all these methods whose application was already frequently and often justifiably the cause of unrest? So the Taylor system was supposed to be merely the intensification of a relentless mechanism of repetitive work which yielded an output bearing the marks of indifferent quality, of extreme specialization, of monotony, of speeding up and finally of overproduction, with all the evils that these bring in their train. They said it was the end of the search for perfection in workmanship, bringing with it the disappearance of that hall mark of the artisan which is the distinguishing feature of the French product.

This was to impute to Taylor all the ills resulting from the haphazard development of the very practices which he condemned. The manufacturers have often been aware of the injustice of their ill-founded criticisms. Indeed, some of them have eventually admitted that the output of their factories was less than it ought to be, but they blamed the indifference of the worker for everything and confined themselves to forcing his utmost exertions by the lure of a premium, thinking that they were applying Taylor's ideas when they were doing just the opposite thing.

These hasty and ill-considered attempts generally ended in an abrupt stoppage which was due largely to lack of coordination of the various operations in the shop.

In spite of this unfortunate beginning Taylor's ideas have made headway. His writings have been better understood and new applications of his methods, made with more care, have been crowned with success.

Then came the war. In this crisis even those who had only imperfectly understood the bearing of the fundamental principles realized that if an exceptional effort was the only way to secure increased production, that effort must be made at least temporarily without further delay in order to procure the artillery and munitions so urgently needed. So the application of the Taylor system became the object of governmental measures. The Minister of War, M. G. Clémenceau, prescribed its adoption in a circular addressed to manufacturers as well as to the Arsenals and Navy Yards of the War and Marine Bureaus and had its fundamental principles explained by lectures.

But it was very soon recognized that time study, the planning room and routing would make it possible to organize production in a manner satisfactory in every respect to the workers, so the government officials, whose sympathy for organized labor has never been concealed, immediately advised the manufacturers to introduce the Taylor System.

From that moment scientific management acquired an important place in industry.

Can it be said, however, that this splendid work and the spirit which inspired it, and the great personality who is responsible for it, have been generally understood and appreciated at their full value?

No work as original as Taylor's can be judged without an intimate acquaintance with the author's mind and with the circumstances accompanying the successive stages of its development. Unfortunately this knowledge has been until now entirely lacking.

What kind of a man was Taylor?

In France there were a few rarely privileged individuals who had had the good fortune to know Taylor personally, and to have met him face to face in his own country as well as in France. He had introduced them into his working environment and they had had long talks with his associates, with his experts and even with his opponents.

These men realized at once that his work was of exceptional significance and that it emanated from a man of a superior type of mind, a genius in every sense of the word.

How could this conviction be brought home to others? Men of genius are rare and the world does not recognize them as such without ample demonstration of their fitness for the title.

"The Taylor of whom you speak," they said in France, "is so far ahead of the one whom we visualize to ourselves; the work which you describe is so remote from the narrow circle in which it seems to have originated that you must have been laboring under a delusion." Or else—

"The friends of Taylor have created two Taylors, neither of which apparently has anything in common with the original. Either they represent him as a scientific mind of such a high type that ordinarily it is acquired only by attendance at the technical schools and the universities, which he knew only in the later years of his life; or, what is even more improbable, they make of him an economist who throws new light on modern industrial development; they even go so far as to see in him the leader of a school of philosophy which pretends to solve the most subtle social problems by entirely new methods and to reconcile the interests of labor and capital. All of this," they say, "is incompatible with such a working man's brain as he must have had and which he even seemed to claim."

Such were the objections which had to be met. Among other things, Taylor's type of mind had to be explained; a type difficult to define, as are all those which do not spring from the common mould.

We knew that Taylor was the product of a cultivated environment. It was, therefore, easy enough to concede that he had acquired a certain breadth of vision, but this did not explain his bent for the scientific point of view. How did it first show itself? What opportunity did it have for development? As he was an ardent sportsman (a tennis champion and a devotee of golf), it is probable that his instinct for precision had found in sports the food which nourished and moulded it into the genuinely scientific form. It was probably in sports also that he acquired respect for voluntary submission to discipline, for securing the most effective cooperation through intelligent functional management and for absolute loyalty in competitive work, all of which lie at the root of scientific management.

Very frequently this manner of explaining Taylor's type of mind was considered an ingenious and amusing invention inspired by a desire to make these novel ideas acceptable to the youth of sporting inclinations in the factory.

In order to give a correct idea of this original spirit and of the influences under which he was moulded, it was necessary to tell the story of his life as Mr. Copley has told it, to review his ancestry and the first signs of his natural tendencies and of his character; to scrutinize the circumstances under which his personality was formed, as well as to visualize the industrial environment in which he first distinguished himself. It was necessary to study his various assignments and to be present at the ardent discussions in which, while valiantly defending his ideas, he was led to give them coherence and to formulate those principles of organization whose economic and social bearing he was demonstrating.

Unlike John Fritz, William Sellers and many others, Taylor is a man with a new principle, rather than the incarnation of a stage of evolution undergone by industry in the ordinary course of events.

He represents an external force penetrating the factory and changing its whole orientation—"a breeze had come into the works—a new force."[1] Being very little understood at first it provoked nothing but ridicule.

Taylor was, indeed, a revolutionary, as Copley has said. But the life of Taylor is also presented to us as the story of a "pilgrimage into industry," the pilgrimage of a man sprung from a very different environment. He was not born into industry and he was not educated by industry. Neither did he undergo the conventional "technical training" which is designed to prepare one for an industrial career, and his sole equipment was a remarkable habit of observation and a very keen critical sense which was subject to rigid discipline by a determined will placed at the service of a high ideal, the love of truth and a desire to serve the common good. In a word, this pilgrimage into industry is the pilgrimage of an intellectual.

How had he acquired this quality of mind?

After following the development of the youthful Taylor in the vivid and detailed chapters of the biography, no doubt remains that Taylor's character is best explained in his passion for sports. It is sport which taught him at an early age the value of the minute analysis of motions, the importance of methodical selection and training, the worth of time study and of standards based on rigorously exact observation. In a word, it was sports which made him understand the necessity of the scientific method and gave him an admiration for the discipline of the arena which St. Paul had already suggested as an example to the Corinthians. Because of these things he qualified as an intellectual. But they did not make a dreamer of him; much less a writer of romances. He does not see things by halves and he is not satisfied with rule of thumb measurements. He demands absolute exactness. He does not waste time on sentiment or seek to build up theories. He is a realist, and if he tries to introduce the sporting spirit into the shop, it is with a definite object in view. He wishes to increase production in order to establish the relations of employer and employee on a fair basis, and as he is essentially a wrestler, obstacles serve only to stimulate him. He boldly attacks everything that does not seem to him to be based on sound foundations, and he does not stop until victory is achieved, victory over matter or victory over men, but victory by which his adversaries are always the first to benefit.

Many people have attributed a workingman's mentality to Taylor. This is an error very promptly dissipated by the reading of his life. Taylor was not developed, as the workingman so often is, in the school of hard necessity. He is not a man who from his childhood has known to his sorrow the necessity of earning his daily bread and the continual fear of losing his job, or a man who in spite of himself has had to submit to painful and more or less revolting tasks; neither has he had to learn the hard lessons of advancement in the face of innumerable obstacles.

"Where can a school be found," asks John Weare, an American writer,[2] "which prepares a man of the most humble origin to leap more or less rapidly over the most diversified conditions of society as so many distinguished Americans do and to reach the first rank of power and fortune? What apprenticeship makes it possible for a young man to begin as hotel porter and end as a statesman or as the captain of some powerful industry?"

The school of necessity.

In France as in America, the greatest men have been trained in this school. If it does not break them it develops their will power and energy so thoroughly that they may attain the highest honors while preserving at the same time the workingman's quality of mind and the strong imprint received in their youth. But this was not the case with Taylor. Taylor became neither statesman nor captain of industry. He might have done so had he been obliged to begin his career by selling daily papers in a railroad train. Evidently his goal was to be a more exalted one. He was able to listen to the voice that calls fortunate souls towards an ideal lying always farther on; first an ideal of spiritual excellence and strength; then an ideal of physical and moral vigor; an ideal of determination coupled with an ideal of fairness and an ideal of duty—and he was able to compass in this way the various stages of intellectual development. He says that very strong will power is not required to excel in the things which one enjoys, while a great deal is necessary to excel in the things which bore or repel one. This is true. But all the more is it required when one is not impelled by urgent necessity. So it seems probable that the first manifestation of Taylor's unusual nature can be seen in the pleasure which it gave him to conquer himself. Following the austere traditions of his family, he imposed on himself that discipline in whose practice the great educators of humanity have found the best means of developing the mind.

---

[1] Copley, Vol. I, page 122.

[2] In a lecture given at the School of Social Economics founded by P. F. Le Play.

The two forces which orient life are attraction and necessity. Their association makes necessity less of a trial and gives to attraction all its creative power. In the pursuit of his ideal, Taylor collaborated with his less fortunate brother, the workman, for whom he felt the most sincere sympathy. He instinctively contributed to the great cause of the well-being of the whole world's workers his good fortune in being free to listen to the summons towards greater and greater heights. He pursued his ideal to its inevitable conclusion, welcoming with joy the day when, without relaxing his activity, he declared "that he could no longer afford to work for money," a decision which surely entitles him to be called an exceptional man.

This is the personality which seems to us to emerge from the pages of Copley's life of Taylor as an example to be pondered by the many young men who are fortunate enough to be free from necessity's carping cares, and who find it so difficult to realize their good fortune in being able to turn their thoughts toward an ideal. It furnishes also a precious lesson for those whose mission it is to educate the youth of their time.

II.

As we have said, Taylor sounded the note of warning, called attention to the inadequate production of industry, condemned the errors practiced, and tried to bring about a change of orientation.

Such an attitude could not fail to make a lively stir in France as elsewhere, and each of the questions raised is worth discussing from the French point of view.

The workman seemed to be particularly the object of Taylor's scrutiny. He denounced with energy restriction of production, "systematic soldiering," which he insisted was a general practice. This point was the occasion of prolonged discussion between Taylor and the workers. It was possible to infer that he would not hesitate to compel "speeding up" in order to achieve his ends, and it was against this that the workers sought to defend themselves, with ample justification.

To what extent does this criticism of the restriction of production apply to the French workman? It is no doubt human nature to perform the minimum amount of work, when, with or without reason, one thinks it is not to his own interest to do more. And there is no question that systematic soldiering is practiced in France as it is everywhere else. But it is none the less true, fortunately, that a love of work exists also and that there are many good workmen who ask nothing more than a chance to use the energy that they can regularly supply on condition that they be properly recompensed. It is even true that they are not averse to speeding up their work when inspired by the desire to increase their earnings, and generally the incentive lies in the necessities of their families.

It is hardly necessary to stress the fact that speeding up is incompatible with intelligent organization, whose object must always be to secure the greatest regularity in output with the lowest possible labor turnover. There can, therefore, be no question of imposing it upon workers or even of approving it. On the contrary, it must be stamped out wherever it exists.

But the workman has also a tendency to limit production for a reason other than fear of fatigue. On the one hand, lack of coordination of the tasks in a shop does not as a rule permit of his exerting all his energy, and on the other hand, he is convinced that the more he exerts himself the more likely he is to suffer unemployment. This conviction is all the more difficult to combat because the workman has experienced it so frequently to his sorrow. An organization worthy of the name gives every guarantee to the workman on this point, but it must convince him not so much by promises, which hardly affect him, as by making a business of demonstrating to him that order reigns in the house from top to bottom, and that no stone is left unturned to insure the greatest continuity of employment, which Taylor's detailed preparation and planning certainly succeeds in doing. Nevertheless, we must recognize the fact that the French workman loves to make an extra effort from time to time in order to be able to enjoy a period of relative relaxation afterwards. Careful selection of the workers, accompanied by methodical planning and instruction such as Taylor practiced, is certainly the first of the conditions to be realized in order to avoid speeding up, at the same time arousing an interest in the work and increasing the wages.

The question is, however, whether the workman is not discredited by a selection involving physical characteristics only and the specialization which results from it? In any case, Taylor is not responsible for specialization. It is inseparable from modern industrial processes, but it is forever being brought about by chance. The man who has to work for his living takes the first job which offers, even if he has none of the requisite qualifications; and he adapts himself to it as best he can, generally none too well. After a while it is extremely hard for him to make a change and there he is, rivetted for life to a job in which, having no aptitude for it, he will never more than passably succeed.

By helping him to orient himself in work which is more suitable for him through intelligent selection and proper training one renders him invaluable service.

Taylor has also been accused of taking no account of fatigue. It is true that he talks very little about it and that he puts the emphasis upon production. But discovering fatigue to be the main obstacle to production, he does not confine himself to calling attention to the evil; he points out the remedy, and no one can deny that the examples which he cites in his Principles of Scientific Management are the best studies in fatigue which have ever been made.

The first example, that of handling pig iron, is a study of heavy work requiring muscular effort which only very robust men can bear, and even they only for a more or less limited period. There has always been an interest in eliminating this kind of work, and the improvements effected have really made it increasingly infrequent. Taylor showed how even in such tasks as these production can be increased while fatigue is diminished, through having recourse to judicious selection and to the organization of proper rest periods, but this point has no longer anything but a scientific interest.

The second example, that of bricklaying, has to do with tasks requiring only a moderate effort, which are much more numerous in a modern shop. It shows the fatal influence of useless motions, frequently more fatiguing than those necessitated by the work itself, and from which the worker can be emancipated by convenient appliances.

Finally, the example of the selection of bicycle balls relates to tasks in which nervous tension is the predominant element. For work of this kind careful selection and proper rest are indispensable. The test of fatigue in this case is the slowing down of the work and the failure of production, which can be accurately measured. Another excellent test of the same kind used by the French is the result of sick leave reports before and after scientific management has been introduced. It is evident that the new methods are reducing fatigue if at the same time that there is increased production and increase of earnings there is also decrease of sick leave. Up to the present time laboratory experiments do not seem to have been able to give such exact figures on this matter.

There is still a question as to whether this problem of production to which Taylor attaches so much importance is as vital a matter in France as it is in America. Is production in France as inadequate as the examples Taylor enumerated? And if it is not as high as it might be, is that fact not more than offset by the quality of the product? May one not fear that an over-developed organization may destroy initiative and ingenuity and that ability to extricate himself from difficulties characteristic of the French workman, so important in the industries yielding those artistic products which occupy such an important place in France?

To answer this question one must be explicit. Not only publicists and philosophers, but economists and even manufacturers are constantly talking of management problems in the vaguest possible way, reasoning about an imaginary shop or workman who produces an indefinable object by an indefinable process. Or, if they stop to investigate an operation offered as an example, it is considered as something intangible and not viewed in its relation to the evolution of industry and to its new tendencies. When they analyze the work they do it in a laboratory, taking the filing vice or the dock workman as a type, and the subjects under observation frequently lack training. Hence the extraordinary evaluations which we have heard.

To better understand the way the Taylor principles may be adapted to French industry let us take a purely industrial point of view and deliberately select a worker on an art product. In his way he is really an inventor; imagination and taste are the first considerations with him. He should no longer be obliged to work at purely mechanical tasks like those he frequently imposes on himself. The finest tools should be within easy reach of him and he should have every facility for preparing his work. This is what he may expect from a well-organized industry such as we are discussing and whose principal operations we shall attempt to define and to classify. These are—

1. *Conception* or *invention,* beginning with an initial idea and permitting the construction of an original model.

2. *Realization,* placed at the service of invention, giving it a definitive form; proving it out by more or less important applications.

3. *Production,* the manufacture of thoroughly defined products in greater or less quantity by the most approved and the least expensive methods.

Invention occupies a very honorable place in France, a fact generally recognized, particularly by Americans. In invention France is extremely active, but she is notorious for the simple facilities which she uses in putting original models on the market. It may be said that scientists and artisans vie with each other in ingenuity in this matter. Industrial organization has been accused of stifling invention, its lack of flexibility making one hesitate to undertake new kinds of manufacture. This reproach cannot be brought against Taylor, for his methods always have a tendency to give more flexibility to the shop. It must be remembered also that invention is not concerned solely with devising a new product; its object may just as often be the contriving of new methods of making a model commercially practicable. It is an immense field and the analysis of work constantly suggests new objectives for this kind of invention which it is hoped the French will be more and more eager to develop.

Realization, the creation of a final marketable model, is an operation differing entirely from the first. According to circumstances it may be rapid, made easily in a short space of time, or it may be laborious, that is, it may demand more or less time and great expense. Examples of the rapid development of an invention are numerous in France. Some time ago the Jacquard engine made rapid strides; French automobiles demonstrated what could be expected of this mode of locomotion before those of any other country. This can be attributed in large measure to special ingenuity in the use of emergency means called by the French "débrouillage." But technical refinement is fruitful in proportion to its facilities. And even such resourcefulness increases in proportion to its facilities, and scientific management comes to its rescue by placing very definite facts and processes at its disposal. In many cases, however, the final development of an invention is bound to be laborious, and it is in America that the most remarkable examples must be sought extending over scores of years and involving expenditures running into millions of francs. In France many inventions have not gone beyond the first stage, or the creation of a definitive model. Realization, in the sense in which we use the term, requires a long time and especially great expense, and has not been pushed to its ultimate possibilities in France.

This was true of the sewing machine which Thimmonnier invented in 1825, the typewriters of Xavier Progin in 1833 and of Foucault in 1842, inventions which have not been developed like those which originated in America for the reasons which we have just given. We would have known very little about the French inventions if it had not been for the models deposited in the Conservatory of Arts and Trades beside Vaucanson's automaton, where their main function is to establish the priorities should they be claimed by others.

This laborious realization can be brought to a successful conclusion only by applying the scientific method to the last degree, as Taylor did for the cutting of metals; and if in the future we wish to reap all the benefit from our inventions without waiting for them to return to us from foreign shores, we must hold on to them and must learn how to find the necessary resources here in France.

Production covers an extremely broad field including systematic mass production as well as production of individual objects. Whichever it concerns itself with, the problem consists in making the best use of all available methods and in assuring a thorough coordination of all effort. This is essentially the problem of output which is generally inadequately understood in both cases. Production has been considered that period when, because there is no further problem to solve and no initiative required, the worker fails to find further interest in his work. The first foreman to come along was supposed to be capable of arranging all questions of detail with which he had to do. They lost sight of the fact that production is continually concerned with the most interesting questions pertaining to methods of production, machinery, tools, material, perfection in finish, interchangeability, and so on, and that mass production itself, in view of an attainable perfection, has made it possible to undertake inventions of tools and studies of material which would have been quite impossible with a limited production. Far from discouraging research, the study of these two kinds of production stimulates and develops a spirit which extends to further researches for obtaining greater perfection in execution. It is this spirit which we must develop in France, and the Taylor researches are certainly the strongest arguments which can be invoked to make us understand their necessity.

After having accused Taylor of destroying all spirit of initiative, it was said that he misconstrued the principle of authority or of unity of command. It is quite evident that the man who takes part in any collective action, of whatever sort, must submit to some authority, and that this authority cannot emanate from several sources. This admits of no argument. It is a useful thing to formulate principles; it clarifies ideas; but today, at least in industry, a passive obedience imposed in the name of however excellent a principle is hardly accepted any more. Moreover, it is not sufficient. In these days authority more than ever before must make itself acceptable, must create and use many types of cooperation. In order to do that it must thoroughly understand its own objectives. What is necessary is that authority "collaborating cordially with the workman" which Taylor predicted and which one may call the French type of authority. They have laughed at the Frenchman who, whether as workman or soldier, has been "willing to obey, but does not wish to be commanded." This has been taken as a joke, but it is no laughing matter. If you prepare the work with the greatest care and arrange the shop in such a way that everyone understands just how things are to be done, the workman will do his part without your being obliged to direct him every minute or to give him imperative orders whose significance escapes him, and which antagonize him. He is, in fact, the same man who says when he comes into a shop where order reigns, "here, at least, one feels oneself under command." He feels it for himself without anyone's being obliged to call it to his attention, which makes the whole situation quite a different matter.

It is in this way that intelligence must be developed in the shop. To this end it is not enough to introduce order; the workman also must receive definite training; he must be led to desire training. But the training of the men in the higher positions, deficient as it frequently is in its knowledge of human nature, must not be neglected.

The workman who is usually educated by life itself and by his environment is not always convinced that his condition as a workman can be improved by schooling. The man who has received his whole training in school is often totally ignorant of life. What can be done to give the workmen confidence in schooling and what is necessary to give the schools a comprehension of life? And especially, what can be done to make the desire for instruction the dominating preoccupation with everyone? It cannot be said that this desire literally does not exist, but it seems to be very feeble with some and very vague and undefined with others.

It is only necessary to follow the arguments raised by questions of instruction to reach the conviction that the problem is the same everywhere. People seem either to learn or to teach without knowing just why. Probably, because it is either a pleasure or a duty to learn or to teach. Manufacturers prefer to employ the students from the schools, doubtless for the same reason, because they expect to find them more capable than others, but without being able to define exactly the knowledge or the qualities that they are looking for. Some of the pupils from the schools are very successful. Is it because they have attended the schools or in spite of it? They belonged to the elect and have a diploma to prove it. Has the diploma any further significance? Has the school done more than bring them together? Have they, too, not been formed also by the environment to which they belonged or by that which they acquired?

When manufacturers are forced to say just what the training of the schools is expected to supply, they extricate themselves too easily from embarrassment by complaining of the absence of general ideas, or the lack of common sense. General ideas! Common sense! They should be more precise, and if it is too difficult to give exact definitions of those terms they should at least indicate the role which these factors which are so important are intended to play. Are they two different things, two extremes, or one and the same thing? Must one see in them a contradiction between the school and life? Moreover has it not been said that one must be a great man to understand the importance of a small detail?

Although eminent authors continue to write about education, they declare in the same breath that their efforts will be wasted. When they point out changes in program or new methods they complain of seeing the same old routines and tenacious prejudices rising up before them to frustrate their reforms. How can one hope, however, to take much interest in a change of methods when the end to be attained is in itself so poorly defined?

In spite of such discouraging facts we have great faith that scientific management will contribute to the bringing together of these currents; that it will make clear the value of instruction and orient it in the right path. The easier its usefulness is to explain, the more often it is proved by simple facts within everybody's reach (such as those which are demonstrated by the analysis and preparation of the task), the more general will become the sincere desire for instruction, and important results are bound to follow.

In a word, a sincere determination to secure instruction must be awakened by an orientation of ideas in accordance with facts. It is the fact which must serve as a point of departure for all teaching if it is to have real strength; the fact to which attention is called even in the shop and the fact on which the professor or the lecturer must place his dependence.

The great economist and engineer Le Play expressed an opinion which it is curious to compare with what we know of Taylor's training and of his turn of mind. It is apropos of the educational value of the thorough analysis of a given fact. "Energy," he says, "cannot take definite form without a determined spirit and a determined spirit cannot be vigorous and far-seeing unless it depends on positive methods of observation of facts." On this point there is remarkable unanimity of opinion between the French engineer and economist and the leader of the American School; but Taylor takes a long forward step when he introduces into the shop these definite methods of scrutinizing facts in order to bring about the desired alliance between all the forces whose collaboration is so necessary.

Early in September, 1913, M. H. LeChatelier invited several friends to meet Frederick W. Taylor, with whose works, thanks to him, they were already acquainted.

After conversing with several people present Taylor opened his talk by stressing two points:

He devoted himself at first to showing the great importance of scientific management (if a terrible crisis is to be avoided) not only from the economic point of view, but because of the necessity of making better use of all the means of production, of continuing to be their master instead of leaving them open to every chance, applying his principle to those means as a whole as well as to each particular case. After which he expressed the conviction that France was better prepared than any other country to make use of his ideas; that it was the country offering the best future for scientific management.

The first statement, relative to the economic bearing of his methods, called for little comment at that time, but today it seems like a prophecy. For we are, indeed, passing through a universal economic crisis which concerns everybody. We complain of the high cost of living. It is not, however, because the means of production are lacking but because they seem to be paralyzed for reasons which it is difficult to define. This crisis has taken us unaware, and doubtless one of the reasons why it is so difficult for us to extricate ourselves is the blind faith, characteristic of our civilization, in the ability of unhampered individual efforts to solve all economic problems. This simple formula coming to halt the hatching of more or less adventurous theories about social organization had succeeded in checking all progress in the middle of the last century. From the year 1848, Frederick Bastiat in his "Economic Harmonies" developed the conception of a natural organization in opposition to the artificial organization of the socialists, that is to the systems of Proud'hon, St. Simon, Fourier, and others. Organization had to give way to political economy. The equilibrium between Demand, Effort, Satisfaction, or in other words between Production and Consumption always seemed to have to settle itself without undue friction. All the more reason for giving it time. To keep in touch with the efficiency of the interested merchant, to keep the accounts straight and to control the results seemed all sufficient. This is what they were content to do for more than half a century, and industry's marvelous development at that time can be attributed to the practical use of this method. With the aid of the steam engine, a good stock of tools made it possible for a shop to increase the number and the quality of its products in enormous proportions. Transportation facilities developed extraordinarily and the resources of immense continents were exploited whose conversion into wealth would have been impossible without the aid of the railroads. The most diverse activities sprang up all over the world and a satisfactory state of equilibrium seemed to exist between them. However, it was too soon to conclude that this would continue to be true.

During the first decades of this new era it was easy to distinguish between industrial countries and agricultural countries, and consequently it was easy to exchange their respective products. But that could not last long. Industry developed, so to speak, in every country, even in those which possessed the greatest agricultural resources, and the exchange of merchandise between countries became extremely difficult and in certain cases quite impossible. Now every commercial transaction must be liquidated in the final analysis by an exchange of goods, gold being a particular kind of merchandise whose principal function is to re-establish the equilibrium when the exchange of other goods cannot accomplish it.

Today the markets are extensive and supplied by such powerful means of production that, lacking an organization able to coordinate its use, the flow of goods is subject to variations of a disconcerting importance and rapidity, occasioning great disturbances in industry. Individual effort, whether industrial or commercial, can no longer depend on its own initiative to point the way to success, and it is necessary to turn for assistance to groups capable of directing it.

But in order that the advisers whose assistance is required, whoever they may be, shall function efficiently, so that the shop may promptly turn its attention to whatever manufactures are considered the most useful or advantageous, there must be great adaptability in the shop. It must make the very best use of all of its resources and of its machinery and especially of its men. Which is to repeat that the economic equilibrium of industry depends on good shop management, the objective of all Taylor's efforts.

Bastiat was almost alone among economists in his faith in natural organization, or rather in the absence of organization. Among those who have shared a more enlightened view may be cited again the eminent engineer-economist Le Play, who had so much influence in France. In his work entitled "The Essential Constitution of Humanity" he writes as follows: "I was determined on one essential point, a recognition that in social science, as in the science of metals, I shall not believe myself in possession of the truth until my conviction can rest on an observation of facts." This sentence shows a remarkable community of thought between two men of great distinction, and by a curious coincidence both of them make the science of metals and social science march hand in hand. They came together, however, from two opposite points of the compass. Le Play first received a scientific education and turned his attention towards the positive knowledge of facts after finding that economists proceeded from much too uncertain premises to establish the calculus of probability with which they were satisfied. Taylor's point of departure was the fact. He insisted on studying it to the last degree, using the scientific method, and he was struck by the importance of the deductions which could be drawn from it. He also contributed to the science of political economy, but by giving it a new turn. He administered the last blow to a calculus of probabilities based on unintelligent statistics and substituted the differential calculus and integral calculus.

When Taylor said that France was the country which would make the best use of his ideas, he certainly expressed a sincere conviction to which great importance should be attached. He was not a man to use a diplomatic commonplace or an expression of banal politeness. Such things were foreign to his nature, tact itself being a doubtful expedient from his point of view. But during the sojourn which he had just made in our country he had observed that eminent Frenchmen had been calling aloud for some time for a man to introduce the scientific method into the shop and without undue presumption he had a right to think that he was, indeed, the man whom they were describing.

Among his precursors is Perronet, well known in American scientific management groups by the quotation which Babbage gives from a table about the operations conducted in the manufacture of pins which must have been established in France in 1760, and have resulted in the observations made by M. Perronet. This reference would lead one to believe that it had to do with an unimportant Frenchman and with a negligible observation. Now Perronet, who is justly entitled to be counted among our great men, was far from an unimportant Frenchman. He was the father of our great public works' engineers, the first scientific engineer in the modern sense of the word, officially entitled in his time "the first engineer of France," a title of the greatest distinction. His opinion of the work on the manufacture of pins has therefore great weight. But although he paid very particular attention to this work he was not the author of the first study which was made of it, the origin of which is exceedingly interesting.

This study already figured, in the form cited by Babbage, in the edition of 1755 of the "Grande Encyclopédie de Diderot et d'Alembert" which says that it was made under its direction by M. Delaire, "who was describing our organization for the manufacture of pins in factories at the same time that he was having printed in Paris his analysis of the sublime and profound philosophy of Chancellor Bacon, a work which in connection with the preceding description proves that a great mind can at times equally successfully rise to the most lofty contemplations of philosophy and descend to the most minute details of mechanics. For the rest, those who know a little of the point of view of the English philosopher when he wrote his books will not be surprised to see his disciple passing without condescension from the general laws of nature to the least important use of its productions."

Among the many descriptions of trades contained in the Encyclopedia that of the manufacture of pins was particularly remarked by scientists and philosophers because its author knew how to show the great number of absolutely distinct operations and the division of work better than the man who had been responsible for describing the manufacture of needles had been able to do. It is doubtless the knowledge of this description which led Adam Smith, who was in close touch with the Encyclopedists, to formulate in 1776 the very important principle of the division of work, but it was Perronet who sought particularly for its practical application.

Perronet is the author of the first scientific study on the construction of stone bridges. We owe to him the modern type of bridge with the flat arch and straight apron. Indeed, there is not a city or river in France where bridges built either by Perronet himself or by his associates or pupils cannot be found. His reputation spread over all Europe and he did important work abroad, a bridge over the Neva being particularly notable. All the work which he does or which he superintends he studies in the minutest detail, submitting it continually to measurement or to experiment to establish the suitability of the materials, the number of men necessary for the different operations, and the cost of production. He predetermines the tasks when he can, and regulates the rest periods of the hand laborers working the pumps.

The progressive stages of a bridge, whose building must take several years, are exactly determined for each operation before beginning the work. He foresees the natural hazards which will impede the progress of the work, and the changes in the general plan which are bound to result. With great care he keeps notes of the actual conditions as they develop, parallel with his previous schedule. He makes use of every scientific help, but he always verifies it, and one may rest assured that if the description of the work of the manufacture of pins attracted his attention, he confirmed the study which had been made of it in every particular. He seems to have been especially impressed in this matter by the stretch of the metal in the drawing of the wire and to have made several experiments along these lines. He may be said to have created standards for the building of stone bridges, based on scientific principles, especially in everything that has to do with the materials which he used.

But he was also the real founder of the Bridge and Highway Engineers, whose organization was assured by l'Ecole des Ponts et Chaussées, which he created in 1767. Thanks to the growth of this body, engineers acquired a social recognition in France which they did not have in any other country and they have held an important place in the councils of the state ever since. When in 1794 Napoleon founded l'Ecole Centrale des Travaux Publics, afterwards called Ecole Polytèchnique, it was l'Ecole des Ponts et Chaussées which furnished the principal members to the organizer, Gaspard Monge. He was a distinguished scholar who also shows a curious analogy to Taylor, for the work by which he is best known is his Principes Scientifiques de Stéreotimie (The Art of Cutting Materials). At that time the materials used almost exclusively by engineers were stone and wood. Masonry and carpentry were the trades to which the scientific method was applied, and it consisted principally in determining exactly the dimensions for carving the stone and the girders which was absolutely necessary for the building of bridges in accordance with Perronet's scientific determinations.

The bridge at Neuilly, considered the first and one of the most beautiful specimens of the bridges of the new school, was made the object of an inauguration assuming the character of an event of the highest importance. It was not merely the inauguration of a public monument, but the inauguration of a bridge constructed in accordance with scientific principles. It was conducted with great ceremony before the King and all the Administration. This was the first step in the direction of scientific management to be signalized in France in such an impressive manner.

This new point of view became very general in France, at least among scientific groups.

The illustrious scientist Chaptal, founder of La Société d'Encouragement pour l'Industrie National, wrote in 1790 in his Eléments de Chimie: "It would be well to say to artisans 'Know your original material better, study the principles of your art more thoroughly and you will be able to predetermine and to calculate everything. It is your ignorance which makes your operations a succession of blind gropings and a perplexing alternation of success and failure.'" Herein lies the essence of the philosophy developed by Taylor, but it must be noted that Chaptal confined himself to formulating a possibility and that if he caught the attention of the artisan at all, it was only in a small way and in individual cases.

The obstacles which paralyzed the efforts of his forerunners had to be overcome and Taylor was the man who accomplished it. He not only undertook to tell the workmen what had to be done to predetermine and to calculate everything, but he demonstrated it before their eyes. To attain this end he had to move a world. It was a gigantic task that he assumed.

So the soil in France was very well prepared for the understanding and appreciation of Taylor's ideas at their full value and it is M. LeChatelier, one of the men educated by this great movement for the application of the scientific method which can be attributed to Perronet, who first called attention to these researches. At the same time there were those among them who were too often made to foresee everything and to calculate everything without having in advance "sufficiently studied the principles of the art"; and this fact gave rise to opposition between theory and practice of such a nature as to make one doubt the efficacy of the application of scientific management to industry.

This is the reason for a certain distrust inspired in France by the expression "scientific management." Taylor is certainly the man who has done the most to dissipate these prejudices and it is right that his name should be used to designate the movement which he inspired.

Another point which could not fail to strike him relates to that spirit of cooperation, to the development of which he attached so much importance. He observed that this spirit prevailed in a large measure in French factories, and that if it were properly directed, if better use were made of it, remarkable results were sure to follow.

American problems are strikingly different from ours. There, abundance; here, an insufficiency of certain products. There, a tendency to large production; here, a tendency to exaggerated restriction. But the remedy is nevertheless the same.

It is the proper organization of work which opens the eyes of the man inclined to get involved too easily in large enterprises, and which also gives confidence to the man whose weakness is an excess of caution. So that it may be said that far from wishing to impose methods on Frenchmen which are not agreeable, Taylor seeks to introduce into America what is best in the French idea and to demonstrate to the French the value of what they already possess, by urging them to make better use of it.

Has France seen Taylor's prophecy realized, and are we the country which has known best how to profit by his teachings? Much remains to be done before this can be claimed. His ideas are really better and better understood, they have penetrated the technical schools, they are more and more often applied, albeit with great prudence, and the name of Taylor has become in France a veritable symbol, the symbol of a new spirit from which great things are expected. But Taylor would surely not have been satisfied with this tribute paid to his name, and we may be sure that he would say to us, "Now that you see what you have to do—do it!"

658.
658.92

Scientific Management Made Clear

Copley's Story of its Genesis and Development More Informing than any Set of Generalizations

By IRVING FISHER
Professor of Political Economy, Yale University[1]

IT MAY seem strange that so technical a subject as that of shop management could give anyone a thrill. But Copley's Life of Taylor thrilled me as much as Robinson Crusoe did when I was a boy. This is not altogether because of Copley's sprightly way of writing. There was a very dramatic quality in the life of Taylor as a great pioneer—lonely, persevering, unappreciated, cruelly frustrated, and yet increasingly triumphant. There is also something thrilling in the thought that Taylor's work has only just begun; that his life work consisted not so much in directly saving millions of dollars to the people of his generation as in demonstrating the possibility of saving billions more in future generations—to say nothing of the more intangible benefits.

As the story of Taylor's life is the story of "The Taylor System," I shall review that system as traced in Copley's book rather than write a conventional review of the book as a book, and I shall quote liberally from Copley in the double hope of affording representative samples for some of my readers who cannot or will not read the two volumes; and of enticing others, as I was enticed, to do that very thing.

It is altogether likely that Taylor would never have been the Taylor we now know had it not been for the accident of weak eyes. Except for this he would have gone to college and, in all probability, entered a conventional profession. Certainly he never would have begun at the bottom of the ladder and entered a machine shop as an apprentice. But that is what he did do in 1874 at the age of eighteen. It was young Taylor's own idea, when he could not go to college, to enter industry. Though he could have been supported by his well-to-do father, he chose to cast his lot with workingmen and take voluntarily the hard knocks which that involved.

Frederick Taylor brought to his work a native ability inherited from an unusual ancestry. He put science into the machine shop because he brought to the shop a scientific mind. Given this unusual combination, given Taylor and the shop, the result which followed was as inevitable as any chemical reaction.

A Genetic Exposition of Scientific Management

In telling us the story of what Taylor did to the machine shop, Copley draws the clearest picture of scientific management which has ever been drawn. There are various reasons why his picture is so much clearer than any other. Besides his vivid method of presentation and the fact that he has two volumes in which to elaborate it, there is the still more important fact that a *genetic* exposition of scientific management, such as a biography requires, is far more instructive than any set of generalizations. To trace the genesis of anything helps us understand it, and this is particularly true of scientific management.

After all, there is, perhaps, nothing qualitatively distinctive in scientific management. Anyone prejudiced against it could exclaim, after reading Taylor's generalized formulae, "That is nothing new. I've always believed in 'science,' 'harmony,' 'cooperation,' 'maximum output,' and 'efficiency,' the things which according to Taylor[2] constitute his system," and then go smugly on his way, missing the point entirely.

Only recently I read a criticism of scientific management by a scholar who had faithfully read Taylor's books, and yet had failed utterly and ludicrously to catch the elusive vision.

But no one can read Copley's account of the actual evolution of scientific management without obtaining a lively sense of its profound value, simply because he sees it grow, *and can measure the contrast between the beginning and the end.*

---

[1] Author of numerous important works in the fields of economics, mathematics and public health; Deviser of the Index Visible and Chairman of the Board, Index Visible, New Haven; Past-President, American Association for Labor Legislation, American Economic Association, Eugenics Research Association, National Institute of Social Sciences, etc.

[2] "Principles of Scientific Management," page 140.

Its progress, however, was always painfully slow. There were few sudden jumps in invention or discovery. Taylor's genius was the proverbial capacity for taking infinite pains.

> An egotistic desire to be original, to do great and glorious things, to be revolutionary, is notoriously a weakness of youth. If Taylor himself really came to do great things, it was just because the desire to do them was early knocked out of him. Beginning in the management field with no desire other than that of adding his humble improvement to what had been found good, he followed a strictly evolutionary course throughout. [Volume I, page 196.]

Ultimately he had the satisfaction of seeing his ideas triumph and command the admiration of all who grasped them.

> "It is my belief," says Mr. Charles L. Holmes, "that in a man's life he has only one great experience, and my great experience was meeting Mr. Taylor." [Volume I, page 375.]

Mr. Copley tells us that scores of men ascribe their development to some contact with Taylor. Justice Brandeis of the Supreme Court says,

> "I quickly recognized that in Mr. Taylor I had met a really great man—great not only in mental capacity, but in character." [Volume II, page 371.]

Milestones of Progress

The chief periods in Taylor's unique career were: (1) the years spent as an apprentice in the Enterprise Hydraulic Works in Philadelphia [1874-1878], (2) those spent as an employee of the Midvale Steel Company [1878-1890], (3) those at the Bethlehem Steel Co. [1898-1901], (4) the remainder of his life [1901-1915] when he played the part of unpaid missionary or teacher of scientific management.

The second period, the twelve years spent at Midvale, with William Sellers, was the most active period of Taylor's life. The four years before going there were years of unconscious preparation for what followed, while after leaving Midvale his life was spent in applying and expanding what he had discovered there.

Of those twelve full years at Midvale, Copley writes:

> Going to Midvale when he was twenty-two and leaving there when he was thirty-four, he packed into those twelve years of his young manhood an aggregate of achievements which, without exaggeration, can be called exceptional. While he was acquiring the expertness at tennis that enabled him to win with Clark the doubles championship of the United States in 1881, he had begun the study at night that qualified him for the degree of M. E. he obtained at Stevens in 1883. From 1878 on to about 1881 he resorted to every method he could think of to force his men to increase their production; then came his time-study, metal-cutting, and belting investigations, and the years of wearing struggle to build up a system and develop an organization that would facilitate the establishment and maintenance of his scientifically determined standards. In the meantime he met the claims of friendship, won a wife, and established a home of his own. In 1883 and 1884 he designed and superintended the construction of a new machine shop having many novel features. In 1886, two years after his marriage, he joined the A. S. M. E., became an attentive student of its papers, and prepared one of his own (on the use of gas in open-hearth furnaces). As a master mechanic and chief engineer he became responsible for all repairs and maintenance throughout the works. And all along he poured out his ingenuity in the invention, not only of management devices, but of purely mechanical; this latter form culminating in the designing, apparently in the latter part of 1889, of his great and revolutionary steam hammer. [Volume I, page 332.]
>
> But the most remarkable part of it is this: . . . he developed, *single-handed,* a system of shop management the like of which never had been known before, and despite the opposition his radically new ways were bound to arouse, put the thing into effect with such success that he brought the entire works around to it. [Volume I, page 117.]

After these Midvale days, Taylor's most notable work was [1898-1901] with the Bethlehem Steel [formerly Iron] Company, where he, with Maunsel White, discovered "high speed steel."

After this, i.e., beginning in 1901, Taylor stopped working for money. He had accumulated a fortune, though only a trifle compared with the fortunes he had made and continued to make for his fellowmen.

In 1910 when the railways were asking for increased rates, Taylor and his ideas came into the limelight because Louis Brandeis, now Justice of the United States Supreme Court, brought forward eleven witnesses to show that by means of Taylor's "Scientific Management," the railways could so reduce their costs as to gain more than by their proposed increase in rates.

This publicity was overdone and, as Taylor feared it would, it damaged as much as helped the movement, especially by encouraging charlatans to rush into the field of "efficiency engineering." Like any other counterfeits, they have often been mistaken for the genuine article.

To Stop "Soldiering"

We may trace the beginnings of Taylor's study in trying to stop the universal "soldiering," or shirking of workmen.

Taylor was convinced through his life that practically all workmen in industry, except the few under scientific management, soldiered.

He confesses that as a workman, he himself "soldiered" with the rest. In fact, he sympathized with them, under the circumstances. Nor did he ever lose their point of view or regard them as solely to blame.

It was because of his loathing of soldiering, or the system causing it, and of his persistent efforts to find some way to stop it that he was led, step by step, to what is now called the Taylor System.

As soon as he became gang boss, he sought to stop soldiering. At that time the only way he could think of was by instilling fear. That was the traditional way and Taylor simply sought to make this fear-method more frightful.

But Taylor did not find it easy to make workmen work against their wills. They tried every possible way to circumvent him, even sabotage, and often nearly persuaded the management that Taylor was responsible for these "accidents" because he drove both man and machine too fast.

Almost anyone but Taylor would have failed utterly, but he knew, from his own experience as a workman, that the soldiering was genuine and the "accidents" a sham, while the management knew, from Taylor's antecedents and character, that he was to be depended upon. He was indefatigable and undaunted even by frequent threats against his life.

He threatened in his turn. He also tried fines. Sometimes in justice, he had to fine himself for misplacing tools or otherwise breaking his own rules.

> This spectacle of his fining himself provided amusement for the entire establishment; but it was an early example of his principle of one law for all, high and low, and the lesson of it was not lost. [Volume I, page 172.]

But neither threats, cursing, fines, firing men, hiring others nor teaching them the trade succeeded, at first, in overcoming the sullen resistance of his men. Ultimately, however, after three years, they got sick of being fined, their opposition broke down, and they promised to do a fair day's work and did.

He had succeeded "in doubling the output of the men on the whole."[3] But he was far from satisfied.

> "It is a horrid life for any man to live, not to be able to look any workman in the face all day long without seeing hostility there, and feeling that every man around you is your virtual enemy." [Volume I, page 5.]

Yet he did not relinquish his faith in fear as a driving force, though he came to feel the urgent need of supplementing this force by other forces. He explored further, and it was this exploration which led to scientific management.

We may perhaps register as the second step in Taylor's progress, a reconsideration of the reasons for soldiering, a clearer diagnosis. Why, he asked, do workmen so generally *want* to shirk? If only workmen could be led to put more will into promoting instead of retarding the work of the shop!

Taylor became conscious of several reasons for soldiering. One was the almost universal ignorance, on the part of the employers, of what constitutes a day's work. Another was the fact that when men work in large groups, individual incentive is lost. A third reason was that the clumsy efforts of employers to remedy this by substituting piece rates for day rates proved self-defeating, for the instant the piece rates operated to increase daily earnings, the rates were cut. Then the workmen "become imbued with a grim determination to have no more cuts if soldiering can prevent it."[4]

A Fair Day's Work

With this threefold diagnosis of the soldiering disease—ignorance of what constitutes a day's work, herding of workmen together, and rate cutting, not to mention other complications—Taylor set out first of all to discover, by scientific experiment, what constitutes a fair day's work in any concrete case.

His main idea was that, once the employer knows that a workman can do twice, three times, or four times what he actually does do, the higher standard can be insisted upon, and piece rates can be established which will not have to be cut.

Here entered the stop-watch idea which later became a chief target of criticism. Evidently the way to ascertain what labor can do is to measure the time it takes.

Taylor tells us that the stop-watch idea was first suggested in his school days at Exeter, when his mathematics professor, Wentworth, used this method for ascertaining what was the proper length of lesson to assign to his classes. He had each student raise his hand as soon as a certain problem was solved until just half had done so, and recorded this last or median time with a stop watch.

Little did "Bull" Wentworth, famous as the author of mathematical text books, realize that this idea, implanted in the fertile mind of one of his students, would play so vital a part in a future Taylor System and be the storm center of a raging controversy!

---

[3] Volume I, page 214.

[4] "Principles of Scientific Management," page 23.

The next step was to make due preparation for such time studies. They must, Taylor saw, be done under standard conditions.

It was evident that a workman's speed must depend largely on his surroundings and equipment, and that time studies would be valueless unless the workman studied was first assured of a continuous and convenient supply of the material worked upon, with standard tools and machines, sufficient light, freedom from interruption and innumerable other preparations to secure the best conditions under which his work was to take place.

Clearly, preparation must precede time study; many of the half-informed "efficiency engineers" who have too often counterfeited Taylor's thorough work have made some of their worst blunders by attempting time studies prematurely.

So Taylor virtually turned his shop, or parts of it, into an industrial laboratory to set up the standard conditions for measuring a day's work. This measurement was accomplished by dint of thousands of careful experiments.

Transfer of Functions

In order to secure such laboratory conditions for his experiments, he found it necessary himself to arrange many details formerly left to the workingman. This transfer of function from worker to management proved to be one of the most essential elements in scientific management.

Instead of the workmen owning the tools they used, in all sorts, sizes, and degrees of repair, the management ultimately established a tool room with tools duly assorted after scientific tests to discover the best tools for each job. These tools were supplied as needed and were sharpened, repaired and replaced through the management.

For instance, Taylor's experiments disclosed the surprising fact that few shovellers know how to shovel, or even know what muscles to use or what size of shovel. His tests showed that a shovel holding 21½ pounds is ideal. This led to supplying different sized shovels for different materials to be shoveled instead of one shovel for all. Taylor was not content to accept the shovels then standard in trade. After his young assistant, Gantt, once reported that for a certain job no shovel big enough was on the market, Taylor said:

> "You would be damn fool enough, would you, to fix a task that would last perhaps for twenty years at 14½ pounds, when you know 21½ pounds can be done, rather than pay $1,000 for fifty shovels to be made?" [Volume II, page 72.]

Task and Bonus

After a day's work in, say, shovelling had been duly determined under certain conditions, the next step was to so remunerate the workman as to induce him to live up to the higher standards thus ascertained. This led to various sliding scale ideas, especially to the "Task and Bonus" (a suggestion of Gantt's). This is a system of payment by which every workmen doing his allotted task within the normal time should be paid a "bonus" of from 30 per cent to 100 per cent above current wage.

> All previous [plans for management] advocated the payment of ordinary wages to give workmen an incentive for doing more or better work, but Taylor paid such wages to induce workmen to accept the standards determined by the scientific method. [Volume I, page 409.]

Under the former plans the stimulus failed to work because of soldiering, and the employer was often none the wiser. Under the latter system, such deceit was impossible.

> It now should be recognized that here, coming into being, was an entirely new thing in management, the "central idea" of which, as Taylor came to describe it, was this:
>
> "a. To give each workman each day in advance a definite task, with detailed written instructions, and an exact time allowance for each element of the work.
>
> "b. To pay extraordinarily high wages to those who perform their tasks in the allotted time, and ordinary wages to those who take more than their time allowance." [Volume I, pages 261-262.]
>
> "We have found for economy that the record which is made up early on the morning of the day following the work, which shows how many men in each department failed to earn their bonus, is the most helpful record in promoting economy. It becomes possible, then, the day after bad work has been done by anybody, to chase it right home, either to the foreman, the teachers, the tool department, planning department, or to the workman himself, and prove right then and there to the men or the department just what they have done that is wrong." [Volume I, page 368.]
>
> "Two-thirds of the moral effect, either of a reward or penalty, is lost by even a short postponement." [Volume I, page 318.]

One by-product of Taylor's measurement of work was to enable him definitely to buy and pay for *work* as such, not the workers' time.

> Undoubtedly his suggestion that those clerks be permitted to go home when they had finished the daily tasks he proposed for them was found nothing less than sensational. [Volume I, page 451.]

Planning

Constant planning was necessary to control and maintain the standard laboratory conditions year in and year out.

This daily planning led to a planning room to schedule the work of each employee and machine.

> Really it all comes down to the homely old adage: first plan your work, then work your plan. [Volume I, page 286.]

To "prepare" fully a shop in the first place, i.e., to place the machinery in the most effective way, to set up a tool room and planning room and to create other conditions such as would enable workmen to work at their best, often required a year or two for its accomplishment.

Taylor's Exception Principle

A well-planned shop will separate the routine from the exceptional. Many an employer is swamped by details because he does not make this separation. Through scientific management, 95 per cent of the mass of letters, reports, etc. (routine matters), never pass over the desk of the employer, so that his time may be devoted to the exceptional 5 per cent.

This daily planning of the work for each individual workman and the daily measurement of their accomplishments led at once to a sifting and selection, better fitting the various men to the various jobs.

> So that, under the plan which individualizes each workman, instead of brutally discharging the man or lowering his wages for failing to make good at once, he is given the time and the help required to make him proficient at his present job, or he is shifted to another class of work for which he is either mentally or physically better suited. [Principles of Scientific Management, page 70.]
>
> For each type of workman, some job can be found at which he is first class. [Volume I, page 180.]

Functional Foremen

The vast increase in the functions of management required sub-dividing and more functions.

> What Taylor did as he found that he could not thoroughly discharge all of his foreman's duties was the most natural thing in the world: he employed assistants. And it was as he pursued this course that he developed a new type of organization . . . what is now termed the functional type of organization to distinguish it from the military type. It is permissible to call it new only in the sense that a difference in degree can amount to a difference in kind. [Volume I, pages 284-285.]
>
> All along he had been moving unconsciously—that is, wholly in natural response to the conditions he met with—in the direction of functional foremanship and its full development, the planning department, and at Bethlehem he became fully conscious of this thing as a definite principle. [Volume II, page 19.]

The difference between a country road and Broadway, between a dug-out and the Woolworth Tower is simply one of degree.

Barth's Slide Rule

Taylor soon discovered that even the simplest problem involved numerous independent variables, and was therefore never really simple. In algebra even equations of one variable may tax the resources of the best mathematician. When two variables are involved, the complications are likely to be enormously multiplied.

But Taylor's problems almost always involved over half a dozen variables. It was Carl Barth to whom Taylor finally turned for mathematical help of a practical kind.

> One day while he was still helping to run the experimental lathe, Barth happened to see the plot on Gantt's desk, and was told by him that he had tried in vain for about six weeks to construct a mathematical formula to represent its curves. Unhesitatingly and abruptly, Barth declared: "I'll eat my hat if I can't work up an acceptable formula this evening and bring it in in the morning." [Volume II, page 32.]

Copley tells us that Barth did not have to eat his hat. The outcome was Barth's wonderful, famous slide rule.

> Magic instrument, that slide rule. By it the most complicated mathematical problems are solved in a minute. An abolisher of guess work, opinions, arguments, debates. A determiner of the law! [Volume II, page 35.]
>
> Writing to General William Crozier in 1909, Taylor, referring to Carl Barth, said: "He is one of the most brilliant minds I have ever met." [Volume II, page 26.]

The most startling discovery of Taylor's was the tremendous difference between the rule-of-thumb solutions of those "simple" problems of industry, solutions often accepted without question for generations, and the true scientific solution with the aid of experiment and of Barth's slide rule.

In one case there was a lively controversy, the slide rule indicating one course of action and "common sense" of the old rule-of-thumb operators a very different course. Both were tried, the result being that all agreed that "the slide rule knew what it was talking about."

We thus see that while Taylor set out merely to stop soldiering, he ended by creating a general system aiming to get the best not only out of workmen, but out of all elements involved in the problem.

Cost Accounting

Every part of Taylor's system required records. One of the most important of these was cost accounting. But he disapproved as "red tape" all records not actually made use of in management. He said:

> "I have known, for instance, cost keeping to go on in industrial establishments through a long term of years with all the expense incident to it, and upon investigation found that the owners and managers of the business were paying little or no attention to the costs which they figured out." [Volume II, page 376.]

> So he removed cost accounting from the general accounting department and placed it in the planning room, while at the same time tying up the cost accounting with the main books in the manner that since has become known as interlocking.

> Placing the cost accounting in the planning room, he made it a by-product of operations, and thus got his costs *coincidently* with the operations. That is to say, the papers and slips he designed to plan and control operations became the documents on which were based both the cost and production records. [Volume I, page 369.]

> In fact, the leading feature of Taylor's general accounting system would appear to be the unerring certainty with which it enables the manager to pick out the cause of any unusual cost or waste. [Volume I, page 365.]

Taylor's system made increased use of brains, and so increased, relatively, the "overhead," an increase justified many times over, Taylor found, by the decrease in running expenses.

The introduction of scientific management itself is, of course, an increase of overhead, and justifiable only as it is repaid with interest in decreased running expenses.

Specific Gains From Scientific Management

That scientific management pays richly is proved by the experience of those who have used it. There may be apparent exceptions due to undue haste or to following the advice of pseudo-experts. But real exceptions seem to be conspicuous by their absence.

Taylor's own verdict is:

> At least 50,000 workmen in the United States are now [1911] employed under this system; and they are receiving from thirty per cent to one hundred per cent higher wages daily than are paid the men of similar caliber with whom they are surrounded, while the companies employing them are more prosperous than ever before. In these companies the output, per man and per machine, has, on an average, been doubled. During all these years there has never been a single strike among the men working under this system. In place of suspicious watchfulness and the more or less open warfare which characterizes the ordinary types of management, there is universally friendly cooperation between the management and the men. [Principles of Scientific Management, page 28.]

Many specific cases are given by Copley.

> The Watertown foundry had an order for a large number of molds for pack-saddle pommels. The first man put on this job made on an average of nine molds a day, and he, backed up by the civilian foreman of the foundry, who was not in sympathy with Taylor methods, contended that this production was ample. A time study having been made of the job, a new man was put on it under the premium plan, and he made on an average of 24 molds a day. . . . And after all direct and overhead charges had been taken into consideration, it was shown that the cost of each mold to the Government had been reduced from $1.17 to 54 cents. [Volume II, page 345.]

These startling contrasts apply to every phase of the manager's problem. The truth is, both master and man have habitually guessed and bluffed. Under scientific management they can guess and bluff no longer.

In one case, after discharging workmen who continued soldiering, training others to take their places,

> ". . . we had within three months increased the output from 15 to 25 tires a day. This output went on, right on the same machine, increasing until three or four years later we had an output of 150 tires a day."

> The big jump in the production of this rolling machine came when the horsepower used in it was "immensely increased" and the men running it were put under Taylor's differential-rate system. [Volume I, page 316.]

Here is another example:

> Testifying in 1912 before that Special House Committee, Dr. Hollis Godfrey, who later became president of Philadelphia's Drexel Institute, said:

> "The first plant under scientific management with which I was connected was the Tabor Co. I had full opportunity there to see all books and figures, and nothing was more impressive to me than the fact that the Tabor Co., with approximately the same number of men and machines as were used under the old system, was turning out three times the production; that it was giving 73 per cent higher wages to workmen; that it had made 25 per cent reduction in the selling price of its machines; thereby producing so much saving to the consumer. Moreover, that this company, which had lost money before the introduction of scientific management, was now and had been making a good profit; that from the condition of a strike and inharmonious relations before the introduction of scientific management there had come about the friendliest feeling between management, workmen and outsiders." [Volume II, page 185.]

On another type of industry, under the management of Mr. Feiss, afterward President of the Taylor Society, Copley comments:

> Only in a general way can we here indicate the outcome at that Cleveland clothing factory, with its eight or nine hundred men and women employees largely composed of immigrants from eastern and southern Europe, and the children of such immigrants. Hours reduced from 54 a week to

an average of about 43 a week; productivity at the same time increased 43 per cent; wages increased on an average of 40 per cent. In 1910 the labor turnover had been 150.3 per cent (what is called a "good normal" for the clothing industry); in 1914 this turnover was 33.5 per cent. Scores of young men and women taught English at the factory, so that all might have a common medium of speech and thus really get to know and *understand* one another. A service department headed by a college woman of the highest type, and devoted largely to raising standards of living, so that all might have a vision inspiring them to learn and to earn. Hundreds of foreigners Americanized—taught not only our language, but our customs, our sports, our songs. [Volume II, page 448.]

The experience with Taylor's system under General Crozier, in the United States Arsensal at Watertown, showed extraordinary gains. As shown by an official report made in 1911:

> ". . . under the new system we accomplished 5.46 times as much work as under the old method of management." [Volume II, page 339.]
>
> "In the case of the 6-inch disappearing-gun carriages, the cost of direct labor was reduced from $10,239 to $6,949, and that of direct labor and other shop expenses from $10,263 to $8,956. [Volume II, page 337.]

Taylor believed that practically every ordinary, or rule-of-thumb, establishment was desperately in need of scientific management.

> "I am well within the limit, gentlemen, in saying [he testified in 1912] that not one machine in twenty in the average shop in this country is properly speeded. This may seem incredible, and yet I make the statement with a great deal of confidence . . ." [Volume I, page 249.]

Ball Bearings

> "The working hours were arbitrarily shortened in successive steps to 10 hours, 9½ and 8½ [the pay per day remaining the same], and with each shortening of the working day the output increased instead of diminished . . . In this case, however, a large part of the improvement was due to the scientific selection of the girls, rather than the shortening of the hours. There is, however, no question whatever that in this case merely shortening the hours also produced an increase in output." [Volume I, page 460.]
>
> "The final outcome of all the changes [was that] thirty-five girls did the work formerly done by one hundred and twenty. [And that] the accuracy of work at the higher speed was two-thirds greater than at the former slow speed." [Volume I, page 464.]

It is interesting to note that the girls first objected to the changes by which in the end they benefited so much.

This is one of several illustrations of the need of initiative of the management. Another was, as Taylor pointed out, that without this initiative of the management, the workers would never have discovered that the ideal shovel load is 21½ lbs.

Bricklaying

One of Taylor's followers, Gilbreth, made a striking application of scientific management ideas to bricklaying. He averaged, after his selected workmen had become skillful in his new methods, 350 bricks per man per hour; whereas the average speed of doing this work with the old methods was, in that section of the country, 120 bricks per man per hour.

Such cases of success as those just mentioned are doubtless star cases—above the average—but success is almost always marked, whenever the system is fairly tried as shown by an extensive study by C. B. Thompson.[5]

The Steam Hammer

One by-product of scientific management is a crop of inventions of which Taylor made several.

His crowning achievement at Midvale in the strictly mechanical field was his invention of the steam hammer.

> He spent one or two years in collecting, from all over the world, data about the various machines that had been designed, until he found instances in which some one of the parts of each of the various machines of different designs had never broken. . . . As a result he obtained a machine which lasted for many years without a single breakdown—the first instance of its kind in the history of that art. [Volume I, pages 197-198.]

High Speed Steel

But the chief example was Taylor's discovery of "high speed steel." His experiments proved that [contrary to all tradition] by heating the tool almost to its melting point and then cooling it with a blast of cold air, a much higher cutting speed could be gained than with a tool which had never been "overheated."

> One engineer has referred to it as a discovery "which is, at a very conservative estimate, worth fifty million dollars per year to the machine industry of this country." We also read that "by means of these high-speed tools, the United States during the World War was able to turn out five times the munitions that [it otherwise] could have done in the same time. On the other hand, if Germany *alone* had possessed the secret of the modern steels no power could have withstood her." [Volume I, page xv.]

Indirect Benefits From Scientific Management

Besides direct material gains from scientific management, there are numerous indirect and less ponderable gains—peace and good will between employer and employee, initiative and ingenuity, self-respect, good habits and improved character.

---

[5] "Scientific Management in Practice," *Quarterly Journal of Economics,* February, 1915, pages 262-307.

The best way to secure good principles in men is to establish them firmly in good habits. Gantt said:

> "They [those working under scientific management] improve under it, both in honesty and efficiency, more than I have seen them do elsewhere. Realizing that substantial justice was being done and that to do their duty was to follow their own interest, it soon became a matter of habit with them." [Volume I, page 330. Quoted from Gantt.]
>
> "With almost certainty they begin to guide the rest of their lives according to principles and laws and to try to insist upon those around them doing the same." [Volume I, page 328. Quoted from Taylor.]
>
> A noted French engineer and steel manufacturer, who spent several weeks in the works of the Midvale Company in introducing a new branch of manufacture, stated before leaving that the one thing that had impressed him as most remarkable about the place was the fact that not only the foremen, but the workmen, were expected to and did in the main tell the truth in case of any blunder or carelessness, even when they had to suffer from it themselves. [Volume I, page 330.]

Thus, while Taylar was arriving primarily at the material welfare of workingmen, he reckoned among the benefits indirectly attained, the spiritual welfare and discipline in the homely virtues he himself practiced as well as preached.

Taylor stoutly defended his system from the charge that it narrowed the man and enslaved him to the machine.

> Thus if the operation of those machines became work calling for less skill in the sense that there was removed from it the planning element, it at the same time, as plain execution, became work requiring more skill; work requiring much greater manual and mental dexterity; work of a greatly improved technic; work calling for a decidedly higher order of these qualities of application and industry that lie at the root of all skill and knowledge and character progress. [Volume II, page 131.]

Not the least important results of scientific management were the shortening of the hours of the workers, the higher wages, and the increased incentive to work that comes when the man realizes that his efforts are being noticed and rewarded.

Taylor's chief emphasis, however, was always on the advantage *to the public* of cheaper prices through increased production.

Using Past Experience

While in the end, Taylor's methods and results were almost always different from the ordinary methods and results, he invariably tried to begin where previous experience left off. He insisted on first finding out all that had been done before attempting to improve on it.

When, for instance, he set out to measure a day's work, "his first step was to look up all that had been written on the subject in English, German and French."[6]

In this case he was misled, rather than helped, by some of his supposed clues obtained from previous experimenters. These had tried to measure human work in horse-power. Taylor wasted much time and effort in trying to get some useful human equivalent of horse-power, much to the amusement of Barth, who warned him of the futility of such a quest.

Although he never deviated from his rule of exhausting every available source of information as to what had already been done, he did come to see the folly of waiting to make sure he was *entirely* right before he went ahead.

He not only never began far away from current practice, but deplored the idea of sudden breaks with tradition. He satirized such foolish innovating by supposing a surgeon teaching a younger man, and encouraging originality as follows:

> "Don't be hampered by any prejudices of the older surgeons. What we want is your initiative, your individuality. If you prefer a hatchet or an ax to cut off the bone, why chop away, chop away! Would this be what the modern surgeon would tell his apprentices? Not on your life!" [Volume I, page 193.]

The Essence of Scientific Management

What, then, is the essence of scientific management? P. T. Barnum, when asked what was the most wonderful thing about his "greatest show on earth," answered "that it pays!"

This is the most important thing about the Taylor System. In its sphere, and without any of the showman's exaggeration, the Taylor System is still industrially the greatest show on earth because it pays so handsomely, not only in cold cash, but in higher values as well.

If it were true that scientific management failed greatly to surpass the rule-of-thumb, its detractors would be right in claiming that it amounted to little except red tape.

It is the enormous difference which scientific management makes to output, wages, and profits, which marks it out as distinctive. "By their fruits ye shall know them."

We have already seen some of the extraordinary results of Taylor's work. We saw that productivity was commonly doubled, or tripled, or even quintupled.

---

[6] Volume I, page 255.

Method Rather than Devices

The present question is what is there in *method* that lies behind these *results?* What is it which makes this enormous difference between the productivity under scientific management and that under ordinary management?

Is the real secret to be found in task and bonus, slide rule, stronger belting, for instance?

The answer, as Copley's book so clearly shows, is both Yes and No. Usually and incidentally, Yes; fundamentally, No.

If we must list the chief concrete aids to scientific management, we find them, according to Taylor, as follows:

> Time study, with the implements and methods for making it properly.
>
> Functional or divided foremanship and its superiority to the old-fashioned single foreman.
>
> The standardization of all tools and implements used in the trades, and also of the acts or movements of workmen for each class of work.
>
> The desirability of a planning room or department.
>
> The "exception principle" in management.
>
> The use of slide rules and similar time-saving implements.
>
> Instruction cards for the workman.
>
> The task idea in management, accompanied by a large bonus for the successful performance of the task.
>
> The "differential rate."
>
> Mnemonic systems for classifying manufactured products as well as implements used in manufacturing.
>
> A routing system.
>
> Modern cost system, etc., etc. [Principles of Scientific Management, pages 129-130.]

In more general terms, scientific management breaks down every task into five principal functions: planning, preparation, scheduling, production and inspection.

But those who seek the soul of scientific management in such devices or classifications are like those who seek the soul of religion in a particular ritual. The great secret of scientific management is not to be found here. Detailed devices might express the difference between any two *un*scientific systems. It might be fair so to describe the difference between Smith's and Jones' systems, but Taylor's system differs from Smith's and Jones' and everybody else's in this—that his methods were not simply favorites to which he took a fancy, but the result of painstaking scientific testing.

> The grand ends to which this system is all directed may be here defined as [1] the determination of best or standard ways, implements, and materials by scientific investigation and experimentation, and [2] a control so extensive and intensive as to provide for the maintenance of all standards in this way reached. [Volume I, page xvi.]

We might, then, define scientific management as management which makes enormously better results by substituting science for guess work. The one supreme criterion of whether an industrial method is scientific or not is found by asking "has that method been *proved* to be the *best?*"

Of course, scientific management, in the ideal sense, has never been attained; in fact, strictly speaking, it is unattainable. When Taylor was testifying in 1912 and was asked: "How many concerns to your knowledge use your system in its entirety?" his reply was: "In its entirety?—none, not one."

A Revolutionary Spirit

But even these attempts to formulate the elusive essence of scientific management are apt to be barren, meaningless, and even misleading to the novitiate. The precondition for substituting scientific management for other management is a willingness to forsake everything traditional if need be, that is, if scientific investigation so indicates. Only through such a "spirit meet for repentance" can the candidate for scientific management ever expect to find the straight and narrow path to industrial salvation.

> It actually was the fact that men to follow after him had to undergo a mental revolution singularly like that of a religious conversion. [Volume II, pages 124-5.]

Huxley, that great apostle of the scientific spirit, used to say that a scientific man must have a fanatical regard for the truth, that he must be ready to sit down before a fact and humbly accept it and all its implications.

That was Taylor's spirit, and history will accord to him the everlasting honor of being the first man in industry, or at any rate in industrial management, to exemplify and utilize that subtle scientific spirit which previously we associated with universities and laboratories.

When we speak of "men of science," we still think of such examples as Huxley, Darwin, Pasteur, Newton, Gibbs, Einstein. That being the case, some university professors quite naturally failed to recognize in Taylor a man of science. But the realm of science is constantly expanding, and in industry Taylor was its prophet and pioneer.

One consequence of this new apotheosis of science in industry was that when "the one best way" was discovered, scientific management paid homage to that one best way as the supreme law. In other systems the supreme law was the say-so of the boss. In the Taylor system the supreme law is the way scientifically proved to be best.

Reign of Law

Taylor is thus the lawgiver of industry. Before his day the government of industry was—in fact for the most part it still is—in the same primitive stage that political government was in before constitutional monarchies came into being. The say-so of the king was the only law. It followed that "the king could do no wrong." Contrast this old doctrine with England's constitutional monarchy today where the king is bound by the law as truly as are his "subjects"!

So it was that Taylor called the ordinary system the "military" system, a hierarchy of arbitrary power in which the head of the business, as captain of industry, simply subdivided the command among departments under lieutenants, who still further subdivided it; as in an army a General's authority is subdivided among Colonels, Majors, Captains, etc. In such a system, each commander's word is the supreme law for those below him. In Taylor's system, on the other hand, every functionary was himself subject to the higher law of what had been proven best.

The following is quoted from the manuscript he prepared for his Harvard lectures, the italics being his:

> "You realize, of course, that the military type of management has been here entirely abandoned, and that each one of these functional foremen is king over his particular function; that is, *king over the particular class of acts which he understands, and which he directs;* and that not only all of the workmen throughout the place obey the orders of this functional foreman in his limited sphere, *but that every other functional foreman obeys his orders in this one respect.*"
>
> "Thus we have a radically new, and what at first appears exceedingly confusing state of things, in which every man, foreman as well as workman, receives and obeys orders from many other men, and in the case of the various functional foremen they continually give orders in their own particular line to the very men from whom they are receiving orders in other lines. For this reason the work of the planning department represents an intricate mass of interwoven orders or directions, proceeding backward and forward between the men in charge of the various functions of management." [Volume I, page 290.]
>
> Actually there is only one master, one boss: namely, knowledge. [Vol. I, page 291.]

Copley says of Taylor himself:

> Imperious as Caesar, *he was not dogmatic or arbitrary.* He did not pretend to be a lawmaker—only a lawfinder. You had to do what he said, not just because he said it, but because he knew the best way; and you had to take his word for this only for the time being, or until the thing could be proved by its workings. If you could prove that yours was the best way, then he would adopt your way and feel very much obliged to you. Frequently he took humble doses of his own imperious medicine. [Volume I, page 175.]

As the novelty of functional management impressed itself on Taylor he realized how hard it would be to convert others to it.

> The prepossession in favor of the military type was so strong with the managers and owners of Midvale that it was not until years after functional foremanship was in continual use in this shop that he dared to advocate it to his superior officers as the correct principle. [Volume I, page 304.]

Science vs. Tradition

Doubtless it might be answered that even the ordinary shop management has its laws or customs to which managers and men are subject. Granted that this is true, nevertheless, the law of tradition and the law of science are as different as night and day.

Practically never can we find "the one best way" by guessing or groping in the dark. One might as well try to predict the next eclipse by guessing. Yet tradition rules our lives more than any other force.

When, after hoary ages of tradition, *science* enters on the scene a battle royal is inevitable. It is therefore no accident that we find the conflict between science and tradition in the biographies of Copernicus, Galileo, Darwin or Pasteur as in Copley's biography of Taylor.

Such a conflict was inevitable. Taylor had to pay the price for disturbing the peace in industry—industry being sublimely unconscious of its shortcomings and unwilling to be reformed.

It might naturally be supposed that if scientific management is capable of enriching employer and employee to the extraordinary extent shown in Copley's account, it would be eagerly adopted by every business concern. The fact that this has not yet happened is sometimes made the basis of childlike argument to prove that there must be something radically wrong with it.

Even today scientific management has to fight its way. Copley's book will help enormously to smooth the path of the Taylor Society. But with the best of salesmanship, progress against the inertia of tradition will be slow.

Copley tells us of Taylor:

> In 1909 he wrote to a fellow worker in the field of industrial management: "I have found that any improvement

of any kind is not only opposed, but aggressively and bitterly opposed, by the majority of men, and the reformer must usually tread a thorny path." [Volume I, page 416.]

Take for instance, the specific example of Taylor's discovery that a stream of water continually poured on the cutting edge of a tool would cool the tool so as to increase the speed of cutting 30 to 40 per cent.

A French scholar, on reading of this discovery, remarked, "[This fact is] so easily verified that one is justified in being astonished that [it is] not known to everybody." Although this fact had been known to the public since 1884, Taylor wrote in 1906:

> "So far as the writer knows, no other shop [than Midvale] was similarly fitted up [with water supply for the machines] until that of the Bethlehem Steel Company in 1889, with the exception of a small steel works which was an offshoot in personnel from the Midvale Steel Company." [Volume I, page 242.]

The disinclination to change expresses itself in every sort of excuse for not changing. Taylor said:

> "It is a very curious fact that each individual manager looks upon his problem as the most difficult there is anywhere in the world, and as having little or no relation to any other problem of management. This is caused by the fact that each manager realizes the special difficulties which he has to face in his own problem, and fails to see that other managers are faced with equal difficulties.
>
> "For example, the man who is managing a simple type of company, in which the work is rather elementary, will say, 'Scientific management can very readily and very properly be applied to an elaborate company, in which there are a great many trades calling for especial skill, etc., but for my company, which is very simple in its nature, scientific management calls for too much red tape.' On the other hand, the manager who is at the head of an establishment calling for intricate work, and work of great variety, will state, 'Scientific management can very readily be applied to the simpler kinds of work, but my work is so intricate and difficult that it can never be reduced to anything like scientific laws or rules.'
>
> "I have hardly ever seen the manager who firmly believed at the outset that scientific management could be successfully applied to his particular work." [Volume II, page 363.]

Obstacles to Progress

All or most of the obstacles which impede progress may be included under the head of conservatism, but in the present case, we may conveniently distinguish six sub-divisions: laziness, ignorance, offended pride, offended special interests, labor prejudice, and false economic theories.

Laziness

Laziness in some degree may perhaps be said to be a universal human attribute. We all dislike the effort required to get out of a rut or habit.

> There still are many thousands of men and women who are so worried and generally upset when called upon to depart from a fixed routine that the only thing you can do is to leave them to the routine or wean them away from it very gradually. [Volume I, page 434.]

It takes gumption to make any change, and after it is made, every nerve must be stretched to keep the new system going full speed. One essential of the Taylor System is that everyone should do his utmost while the natural tendency is ever to play the slacker. It is the old conflict between our higher and lower natures. We like to see others try but seek to avoid the strain ourselves.

The following shows how insidious is the tendency to back-slide and take it easy.

> Though Midvale did not throw out Taylor's methods, it began, not long after he left there, to slough them off . . . For this sloughing or sagging, there is a ready explanation: no one at Midvale except Taylor himself was imbued with the philosophy that lay back of his methods and mechanisms. In his later years, Taylor came to see clearly that scientific management could not exist in any establishment until chief executives, planners, supervisors, and executors or operatives all had undergone the "complete mental revolution" involved. [Volume I, pages 339-340.]

To Taylor, laziness was a deadly sin. He disliked seeing anyone do less than his best. "What William James calls *the habit of inferiority to your full self,*" was his special object of attack. The "one best way" seemed, in Taylor's mind, to stand out not as the top of a rounded hill, but as the sharp peak of a mountain.

He disapproved not only of lazy workmen but of lazy managers. He believed they often put details up to the workman not really because they thought this the best way, but simply because "the management was disinclined to assume the duties, burdens and responsibilities that naturally belonged to it."[7]

Ignorance

As an example of ignorance, we find the curious spectacle of a great captain of industry under the traditional "military" system, ruthlessly replacing scientific management by his own accustomed methods, without, apparently, knowing or wanting to know exactly what it was which he was throwing away.

Taylor wrote to General Crozier in 1910:

> "I think it is quite remarkable that our system should have survived as well as it appears to have done at the Bethlehem Steel Company. I think I told you that the moment Schwab took charge of the Bethlehem Works in 1901, he ordered our whole system thrown out. He saw no

---

[7] Volume I, page 241.

> use whatever in paying premiums for fast work; much less in having time study men and slide rule men, "supernumeraries," as he called them, in the works at all. His orders were obeyed, and the output of the large machine shop in the following month fell to about one-half of what it was before. ——— ———, who was then in command, ordered our system reinstated. He, however, did not tell Schwab that he had done so. On the contrary, he led Schwab to believe that our system had been entirely thrown out. In carrying out this deceit, for several years the use of our slide rules and time study, etc., was carried on in the Bethlehem Works without Schwab's knowledge. The slide rules were operated in a room back of the kitchen, which Schwab never visited, and all of the slide rule, time study men, planners, etc., were carried on the payrolls as mechanics; that is, machinists who were supposed to be working in the shops. And it is only through an accident that this state of affairs was finally brought to Schwab's attention. The office of the large machine shop burnt down some years later, and destroyed all of the slide rules, and many of the time study records. During the year following this fire, the output of the machine shop necessarily fell off to a tremendous extent, because the mechanism for helping the workmen to do a big day's work was lacking. They attempted to guess at what was a proper day's work, as is done in other establishments under the old system of management, with the result that at the end of the year practically all of the head men connected with this department were discharged for incompetence, and a set of men inferior to them were put into their places to run the shop.
>
> "This led to the true facts being brought to Schwab's attention, and from that time forward the slide rules and time study men, and in fact all of the elements of our system of management were practiced openly in the shop." [Volume II, pages 160-161.]

Old-fashioned managers find it hard to realize the importance of any radical departure from the creed handed down to them. In one case, Taylor's recommendation that a higher priced workman be employed to do certain work was rejected because such pay for such work was unprecedented. The result was that the system failed to work until Taylor appealed directly to the company's chief executive. "Would you," he asked, "expect an engine to work with a broken connecting rod?"[8]

Offended Pride

Quite naturally, although unreasonably, when any manager or foreman was asked to mend his ways, as prescribed by scientific management, he considered such request as a personal reflection on himself. It is hard for anyone to admit that he has been doing his work wrong all his life.

> Nine-tenths of his [Taylor's] troubles were with men in the management. As he extended his functional principle to management, it acted on the typical foremen or manager of his day "as the proverbial red rag on the bull." [Volume I, page 292.]

In one instance

> The superintendent was distinctly displeased when told that through the adoption of task management the output, with the same number of men and machines, could be more than doubled. He said that he believed that any such statement was mere boasting, absolutely false, and instead of inspiring him with confidence, he was disgusted that anyone should make such an impudent claim. [Principles of Scientific Management, page 98.]

The average man, once in a rut, wants to be let alone. When he is disturbed he finds innumerable grievances.

The men who most resented Taylor's innovations were, naturally, those nearest to him. They could not abide his being their teacher.

> He must needs be conscious of his power, and he manifested this consciousness in an insouciance which if you could not know what a modest man he was at bottom, you were likely to find more trying than outright boasting. [Volume II, page 21.]

Often, therefore, he found himself a prophet not without honor save in his own shop.

> Even when he [Taylor] in collaboration with Maunsel White, made the discovery [of high-speed steel], which was the sensation of the industrial world here and abroad and saved the company a prospective expenditure of at least a million dollars, none of the men high up in that company had sufficient pride in it to offer him a word of congratulation. [Volume II, page 78.]

In March, 1901, Taylor wrote the President of the Bethlehem Company:

> "It is a curious psychological fact, and one for which the writer can find no explanation, that of all the parties who have visited the works and are acquainted with what has been done here, the only ones who have failed to congratulate the writer upon the results accomplished are, with one or two exceptions, the leading officers of the company." [Volume II, page 113.]

Offended Special Interests

Scientific management, by disclosing the truth, must needs expose many shortcomings which had previously been concealed. Every bluffer fears to have his negligence or incompetence revealed. Such people, whether managers or workmen, naturally oppose scientific management knowing that they will lose thereby their previous advantage from deception, or even lose their jobs.

Every innovation will expose someone who profited under the old regime. One of the most curious cases was when at Bethlehem, "Speedy" Taylor reduced the number of pig iron handlers so far that real estate agents feared he would disturb rental values of tenements!

---

[8] Volume II, page 183.

Organized Labor

The opposition to Taylor thus far described was merely the natural spontaneous opposition of individuals. But we now come to an organized opposition, the most remarkable and regrettable of all.

Organized labor then as now represented the accumulated hostility of several generations of grievances against employers.

Between the two classes a great gulf was fixed. Anything originating with one side was suspect to the other. And the more grievances any labor group felt, the more its hostility to the Taylor System.

> Experience others have had in developing scientific management indicates that the difficulty of getting the workmen in any particular establishment to adopt the new methods always is in nice proportion to the lack of consideration that there has been shown them in the past. [Volume I, page 421.]

Labor leaders, in particular, charged as they were with the responsibility of leading in the fight of labor against "Capital," were active in opposing the introduction of the Taylor System.

Probably today millions of labor men think themselves opposed to Taylor's ideas, and scientific management.

This is remarkable because the individual workmen under scientific management soon come to realize that they are beneficiaries under the system. In particular they have higher wages by from 30 per cent to 100 per cent. The result is as already stated, that wherever the Taylor System has been established, strikes are practically unknown.[9]

Yet history teaches that we often crucify our best friends. It will be recalled that Taylor's first efforts were aimed at breaking up soldiering, that the bitterness of that early fight convinced him of the need of a more thorough measurement of a fair day's work and that this study led to the discovery—for discovery seems to be the right name for it—of scientific management.

Antipathy of Unions

So fate decreed that Taylor's life quest to find a way of enlisting labor's enthusiastic cooperation ended by incurring their organized bitter opposition. Labor's reluctance to labor remained because entrenched in their traditions and organization.

Labor unions originated for the purpose of fighting employers rather than cooperating with them. They had capitalized the idea of soldiering in their mistaken dogma of limitation of output and had fortified that idea by the fallacious economic theory that the more we "make work," the higher wages will be and the less unemployment.

"Speedy" Taylor stood for speeding up industry. Organized labor stood for slowing it down. Taylor regarded the difference as irreconcilable, so long as labor adhered to doctrines contrary to his principles, such as limitation of output and equality of pay for good and bad workmen alike.

The union leaders feared that either the unions must destroy the Taylor System or the Taylor System would destroy the unions.

An interesting instance of the working out of this drama was at Mare Island, California, where Naval Constructor Evans, of his own initiative, introduced the Taylor System in the navy yard with the following results, before misguided labor leaders "got busy"!

> The lowest direct labor cost of retubing boilers at Mare Island had been $1,200 per boiler. When this work was "Taylorized", the cost per boiler was reduced to $400. Six or seven sailmakers were brought to do the work that previously had taken thirty. [Volume II, page 308.]

Three or four years later, after bitter political fighting, backed by labor unions, we read:

> Then came to Mare Island from Washington a party of six line officers to tear to shreds about everything Evans had done there during three and a half years to establish an efficient system. Under the regime that followed it was forbidden to keep any labor records. [Volume II, page 312.]

As soon as organized labor had declared war on scientific management, scientific management was under a cloud. Employers who used it tried to conceal the fact for fear of labor troubles and often do so today.

> In a letter written by him [Taylor] in July, 1912, to L. P. Alford, of the A. S. M. E. Sub-committee on Economic Administration, he, referring to this highly exceptional railway official, said:
>
> "Mr. ——— used our methods for several years while he was master mechanic of the side lines of the ——— R. R., with headquarters at ———. He did really a wonderful piece of work in getting all of the repairs of the locomotives made on piece work, some twenty different types of locomotives being repaired on the side lines. He showed me, in fact, several books containing some 120,000 different piece-work prices for repairing locomotives.
>
> "He came to see me about his work a number of times, and was most enthusiastic. When, however, the Congressional Committee wanted to get him to testify as to what

---

[9] See Volume II, page 162, and "Principles of Scientific Management," page 135.

he had done in this matter, he told me that if they forced him to come before them, he would be compelled to give them no information whatever. They subpoenaed him, and when he went there he denied that he ever had done anything in the line of scientific management whatever. He justified this to me by saying that if he had come out frankly before the committee and said just what he had done, that in the first place the people in his own railroad would have jumped on him; second, that lots of lines friendly to the ——— line would have complained that their master mechanic acknowledged that there was good in scientific management; and third—and most important of all—that the unions in the ——— R. R. would be very apt to antagonize him, and, as he said, 'It would take three years to recover from the harm that I would have done to my work by my testimony.'" [Volume II, pages 374-5.]

Congressional Investigation

One result of Taylor's fight with labor unions over Government work was a congressional investigation of the Taylor System under William B. Wilson, later Secretary of Labor, Congressmen John Q. Tilson and William C. Redfield.

Labor, unfortunately, seemed to have made up its mind, in advance, and the labor representative, presumably under instructions, really did not investigate.

Mr. Redfield and Mr. Tilson spent hours in Taylor establishments, but Mr. Wilson, the labor representative, not a single minute. [Volume II, page 405.]

The object of the labor unions was to secure legislation throwing out the Taylor System in governmental workshops. This the Committee refused to recommend.

Said the committee [House Labor Committee]: "Your committee does not deem it advisable nor expedient to make any recommendations for legislation upon the subject at this time." [Volume II, page 349.]

Beyond this negative approval of the Taylor System, the Committee discreetly declined to go.

Their recommendation against legislation was, however, not successful in stemming the tide of opposition to the Taylor System.

"The scheme was resorted to of attaching to appropriation bills this rider:

"PROVIDED, That no part of the appropriations made in this bill shall be available for the salary or pay of any officer, manager, superintendent, foreman, or other person having charge of the work of any employee of the United States Government while making or causing to be made, with a stop-watch or other time-measuring device, a time study of any job of any such employee between the starting and completion thereof of the movements of any such employee while engaged upon such work; nor shall any part of the appropriations made in this bill be available to pay any premium or bonus or cash reward to any employee in addition to his regular wages, except for suggestions resulting in improvements or economy in the operations of any Government plant; and no claim for service performed by any person while violating this proviso shall be allowed."

The chief speaker for the proviso was Senator Henry Cabot Lodge, of Massachusetts, who made these astonishing remarks: "The very fact of a stop watch implies strain on every faculty, on every physical power, driving the heart and lungs and every muscle to the utmost possible point . . . ."

"The greatest disappointment of the whole debate to me is the disgusting demagogery of Lodge . . ." [Taylor in a letter to General Crozier, March 3, 1915, Volume II, pages 350-1.]

The adoption of this rider in 1915 was, politically, a great triumph for organized labor, and a crushing defeat for Taylor and his system. The whole episode of labor's hostility must nearly have broken his heart and may possibly have had something to do with his death, soon after. For his highest ambition was to help the laboring man.

Labor's False Economic Theory

It would be interesting to speculate on what might have happened had Taylor and Labor gotten together on the advantages of scientific management. It seems altogether likely that by this time the real income of labor, what they purchase with their money wages, would be double what it is.

In the end labor gains, and, as a class, gains the most from so-called "labor-saving devices," and scientific management is the greatest labor saving device in the world. Just as labor opposed the introduction of the machine loom because it would throw hand loom workers out of work, just as stage coach drivers opposed the railways, and teamsters opposed pipe lines, so labor opposes scientific management. Yet in all such cases, labor really benefits, and benefits greatly through increased production. The scientific management which makes more shoes and clothes decreases the real cost of shoes and clothes; real wages consist partly in shoes and clothes. Scientific management which makes bricklaying more rapid makes the rents of brick houses more available; real wages consist partly of house shelter.

Had labor leaders been more far-sighted or clear sighted and joined in the task of convincing their followers that the true interests of labor lay in scientific management, labor unions today would have more prestige than they do and would not be playing so negative and obstructive a rôle. Labor unions have done much to prevent individual laborers from being imposed upon. The idea of organized labor is legitimate and wholesome. But in this case they have failed to serve their own ends.

In order to accomplish this, it would have been necessary for labor to abandon the two doctrines of limitation of output and equal pay for unequal work, and to have substituted the opposite, or Taylor, doctrines of maximum production and of a labor reward varying with individual productivity.

The transition from the former pair of doctrines to the latter pair means so tremendous a gain to labor that I cannot but believe that some day labor will receive the change gladly and organized labor will be leading the movement.

It will help enormously toward that end if once the make-work fallacy can be exploded in the minds of workingmen.

Fortunately the lessons of the war and of Russia since the war have not been altogether lost. The late Mr. Gompers has been quoted as saying, "Efficiency in industry is of paramount importance." Sometimes a labor union, in stigmatizing the management as inefficient and not sufficiently helpful to the workman, has sneeringly said, "Why, they haven't even a planning department!"

The mistake of organized labor was natural and inevitable because, after all, there is a grain of truth in the idea that speeding up production sometimes fails to help labor as it should.

Taylor Partly at Fault

It is altogether likely that Taylor was himself to blame for much of the antagonism he encountered. As Copley says:

> It is to be reported also that there are those who feel that if Taylor could have lived to witness the change in the attitude of many labor leaders since the World War, he would have modified his own attitude towards trades-unions. [Volume II, page 431.]

I think part of Taylor's opposition to unionism was due to confusing the idea of collective bargaining with the idea of unindividualized pay. A union could surely bargain in behalf of all its members without demanding equal pay for unequal work.

Labor unions could conceivably take the initiative in demanding scientific management. If we compare a baseball team to a corps of factory workers we note that they do not wait for the baseball manager to perfect their play nor seek in every way to avoid each man playing his best and, instead, do the least he can until driven by the manager!

As has been said, Taylor encountered more opposition from management than from labor, but management's opposition was purely individual and never came to a head in organized fashion as did labor's.

Not only has the laboring man seen rate-cutting take away piece rate incentive as fast as offered, virtually making the worker into a donkey following an ever receding bundle of hay, but he has seen scientific management constantly throwing people out of their jobs.

One can scarcely expect him to have faith that somehow, somewhere, these temporary disadvantages will more than be made up. Better a bird in the hand than two in the bush.

Taylor's system did obviate the hateful rate-cutting. To do that was one of his chief objects from the start. But it did not directly obviate their temporary unemployment; on the contrary it sometimes increased it.

Had Taylor added to his cardinal idea that piece rates once scientifically determined ought never to be cut (except under very extraordinary circumstances) a second cardinal idea that the same scientific management by which any workman should lose his job through no fault of his, should assume the responsibility of finding him another, one of the very greatest objections to his system in the minds of workingmen would have been removed.

Employers at Fault

Moreover, capital cannot throw the first stone at labor for believing in restriction of output. Has not capital often sought to corner the market and sometimes destroyed part of a crop which was a drug on the market? Has it not cried for "protection" from foreign competition? Curiously enough even Taylor was misled by the argument for "protection" while decrying the fact that workmen were misled by the basically similar fallacy regarding restricting their output.

One great stumbling block which alienated many labor men or labor sympathizers was the socialistic idea that labor is the sole producer, or, at any rate, deserves a much larger fraction of the product than he gets.

Taylor's practical answer was that squabbling over the division of spoils is a waste of time, in view of the possibility, under scientific management, of increasing everybody's share by increasing the total.

Taylor's Faith in Community of Interest

One of the most striking points which Copley brings out is Taylor's sublime and, I believe, well justified, faith that, in a very practical sense the antagonism of interest between employer and employee is more apparent than real.

> [Taylor] believed that greed arises from ignorance, from not knowing where your interests (i.e., ultimately and permanently) lie; and he believed he had started a movement destined to prove to employers as a class that greed does not pay . . . . that one cannot take advantage of the other without ultimate injury to the interests of both. [Volume II, page 424.]

That is, he believed, with David Harum, "it ain't a bad idea to be willin' to let the other feller make a dollar once'n a while." The employer should, in self interest, pay his employees well, and the laborer should, in self interest, help his employer earn handsome profits. Each affects the other so intimately that any attempt at over-reaching on either side does the over-reacher more harm than good because it reduces the total to be divided faster than it increases his share. That there is much truth in this idea, Taylor's experience proves. Accordingly he believed "that the cure of poverty lies not in a redistribution of wealth, but in an increased production."[10]

Yet so intent are socialists on getting for labor a larger *fraction* that they oppose a system which gives it, they think, an unfairly small fraction even though it amounts to much more than labor ever got before.

Upton Sinclair inveighed against increasing pig-iron handlers' pay only 61 per cent, while the work they turned out had been increased 362 per cent. He thought their pay should have been increased 362 per cent.

> Taylor's reply to this young man (Sinclair) probably represents the most careful statement of his industrial philosophy he ever made . . . . .
>
> "Doubtless some of those who like Mr. Upton Sinclair are especially interested in workingmen will complain because under scientific management the workman when he is shown how to do twice as much work as he formerly did is not paid twice his former wages, while others who are more interested in the dividends than the workmen, will complain that under this system the men receive much higher wages than they did before. . . .
>
> "Mr. Sinclair sees but one man—the workman; he refuses to see that the great increase in output under scientific management is the result not only of the workman's effort but quite as much also of the study of pig-iron handling by the management and of the cooperation of teachers who help him and the organization which plans and measures his daily tasks, etc. . . ." [Volume II, pages 51-2.]

Taylor's Wage Principles

Other statements of Taylor's industrial philosophy merit quotation here:

> "Mr. Barth here has perhaps been the most efficient man of all the men who have been connected with scientific management in devising new methods for turning out work fast. I can remember—one or two—instances in which almost overnight he devised a method for turning out almost twenty times as much as had been turned out before with no greater effort to the workman. In that case you could not pay the workmen twenty times the wage. It would be absurd, would it not?" . . . . [Testimony of Taylor, Vol. II, page 127.]
>
> "It is just and fair that men of the same general grade (when their all-round capacities are considered) should be paid about the same wages when they are all working to the best of their abilities. (It would be grossly unjust to other laborers, for instance, to pay this man 3.6 as high wages as other men of his general grade receive for an honest full day's work.)
>
> ". . . It is a significant fact that those workmen who have come under this system during the past thirty years have invariably been satisfied with their increase in pay while their employers have been equally pleased with their increase in dividends." [Vol. II, pages 53-4.]
>
> "And this third great party [the public] should be given its proper share of the gain. . . .
>
> "In the past hundred years, for example, the greatest factor tending toward increasing the output and thereby the prosperity of the civilized world, has been the introduction of machinery to replace hand labor. And without doubt the greatest gain through this change has come to the whole people—the consumer." [Vol. II, page 52.]
>
> "The one element more than any other which differentiates civilized from uncivilized countries—prosperous from poverty-stricken peoples—is that the average man in the one is five or six times as productive as in the other." [Vol. II, page 54.]

Prerequisites of Scientific Management

Perhaps there should be added to the preceding formidable list of obstacles always standing in the way of scientific management the fact that its introduction, under the best of conditions, requires time and patience.

Even believers in it sometimes lose their enthusiasm when they learn that several years are often needed before scientific management can be developed.

> It is impossible to hurry it beyond a certain speed. The writer has over and over again warned those who contemplated making this change that it was a matter, even in

---

[10] Volume I, page 151.

> a simple establishment, of from two to three years, and that in some cases it requires from four to five years.
>
> The first few changes which affect the workmen should be made exceedingly slowly, and only one workman at a time should be dealt with at the start. Until this single man has been thoroughly convinced that a great gain has come to him from the new method, no further change should be made. [Principles of Scientific Management, page 131.]

And after the system is set up its wheels creak at first and require readjustment.

> Again and again they would set their system going, only to have it fall down. Says one of these engineers with more force than elegance: "After every fall down, you pick the system up by the scruff of its neck, give it a kick, and it goes on again. And so it continues until one fine day, lo and behold! it proceeds as if by a miracle to work and keep working of its own accord." [Vol. II, page 183.]

To install genuine scientific management, the practical requisites seem to be

1. That the existing management should first "get religion" on the subject.
2. That they should employ one or more persons trained in the system.

The latter employee need not necessarily be given authority though Taylor always insisted on that. Possibly in pioneer days it *was* necessary; but today Gantt's idea seems more reasonable.

> If Taylor's slogan was "no responsibility without authority," Gantt told you that as a consulting engineer he wanted neither responsibility nor authority; it was his method to have you come to him that he simply might advise you what to do. [Vol. II, page 23.]

Today there are only a few genuine scientific management experts available. As the demand grows the time will surely come when provision must be made for training such experts in large numbers.

Taylor and the Colleges

The universities or the technical schools are the natural places to look for solving this problem of training up a sufficient number of such men.

Just as other engineering training started in industry but had to be taken over by the universities, so management engineering must follow much the same course. And just as the universities now turn out annually thousands of engineers in other fields, so in this field of management engineering must they begin to supply the demand for basic training.

Taylor was reluctant to approve of this step when Professor Gay of Harvard first proposed it, and doubtless Taylor was right, at least to this extent, that in the education process the shop must be used as well as the training school. But this is also true in some degree, in other engineering—in fact in every occupation.

In his attitude toward university education, Taylor showed the usual limitations of a self made man.

> Now, it may be that, despite his scientific bent and his instinctive appreciation of the value of "book learning," he absorbed some of the prejudice against college folk that was general in American industry in his Midvale days. [Vol. I, page 125.]

In a letter to Miss Laura D. Gill, of Boston, member of a "Woman's College Committee," he wrote:

> "I think that functional management should supersede both the committee organization by which some of our universities are managed, and the "benevolent tyrant" who runs the rest of them . . . . . ." [Vol. II, page 268.]

It will be a curious turn of the wheel of fate, if, as seems likely, Frederick W. Taylor's fame shall ultimately be kept alive in our great universities, most of all.

This is not saying that the present system of education does not deserve the particular rebukes administered to it by Taylor in his University of Pennsylvania address on Technical Education and in other statements, such as that just quoted.

But however great the shortcomings of our universities and technical schools (and they seem no greater than the shortcomings of our shops) they are the only known sources of systematic higher education and what the scientific management movement now needs is such systematic education.

Taylor's Shortcomings

Taylor, with all his acute consciousness of the shortcomings of academic institutions, was likewise conscious that he had shortcomings of his own, by virtue of not having the liberal training he criticised.

> With his friend Birge Harrison, the painter, or his friend Frank L. Babbott, a connoisseur, he would stand before a picture and ask for an explanation of what made it great. It was obvious that he groped for the laws governing this thing. He groped also for the laws governing intangible things like ethics and morals and religion. He groped for laws to which he had been obedient all his life, but which he could not formulate; his mind having been trained to deal almost exclusively with tangible things and tangible proof. He did not deny; he simply could not follow . . .
>
> He was kept humble by his knowledge of the ability he did not have and the things he did not know. There was much that was wistful in his attitude toward men who spoke familiarly of things upon which he felt he had no light. [Vol. II, pages 436-7.]

Psychology of Labor

The shortcoming which, I believe, chiefly handicapped him in his professional work was his failure to give due attention to that important intangible, labor psychology.

This criticism has often been made and has called forth vigorous defense from Taylor's friends who point out how thorough and intuitive was his knowledge of human nature and how uncanny he was in fixing the attention of workmen on what they were to get instead of on what they were to give.

Doubtless all this is true, but it is quite inadequate. It seems certain that Taylor regarded the material side as primary and the psychological as secondary. He never consciously and scientifically set out to produce mental contentment by endeavoring to satisfy due fundamental instincts of workmanship, self-respect, loyalty, etc.

Taylor realized, however, the existence of this field of study.

> There is another type of scientific investigation which has been referred to several times in this paper, and which should receive special attention, namely, the accurate study of the motives which influence men. [Principles of Scientific Management, page 119.]

That Taylor should explore this psychologic field with the same systematic thoroughness with which he explored the material side of the problem was scarcely to be expected, not only because his talents ran in a different direction, but because practical psychology, especially of "the subconscious mind," had in his day not developed very far.

Had Taylor lived a few years more, I have no doubt he would have welcomed and made systematic use of the important findings of Robert B. Wolf, who has, more than Taylor, stimulated workmen by non-monetary incentives such as by having them keep score on themselves by charts. Like Taylor, Wolf often obtained surprisingly great results.

Again, Taylor would doubtless have welcomed, and made use of "Golden Rule Nash's" ideas, one effect of which is to interest workmen in what they give as well as in what they get. Similarly he would have welcomed the revolutionary idea of Henry S. Dennison, by which those who actively manage an established business become the chief common stockholders or "partners" so that the rewards or penalties for the policy of a business accrue to those responsible for the policies—a principle quite analogous, though in a different field, to that of the "bonus" for workmen.

Such shortcomings as these in Taylor's original system are being remedied. His followers can best honor Taylor, not as some would have it, by following literally his exact procedures, but by adopting his truth-seeking, iconoclastic, ever-ready-to-improve spirit and by improving a little on him as he improved so much on his predecessors. The best way to honor a prophet is to be a prophet.

Some Other Ideas of Taylor

Taylor applied his very practical idea of making the workman's reward fit his individual performance in criticism of profit sharing for workmen. The fact that the system of profit sharing pools the workingman's interest instead of rewarding each in proportion to his efforts was, to him, a fatal objection.

Taylor had many other practical suggestions for industry aside from scientific management, strictly speaking. He believed that directors of a company ought not to be selected chiefly on the basis of their financial interest.

> "One man should be selected for his financial knowledge, another for his general knowledge of the subject of management, a third for his technical knowledge of the needs of the trade and general knowledge of the selling side of the business; a fourth perhaps for his legal knowledge and yet another for his engineering knowledge which should fit him to direct progress in this line. . . ." [Vol. I, page 418.]

He believed financiers generally ill adapted to conduct industry in a sound way and for the best permanent interests of those concerned. He wrote to a friend:

> "Personally my experience has been so unsatisfactory with financiers that I never want to work for any of them. . . . . . As a rule, financiers are looking merely for a turnover. They want to get in and out of their business quickly, and they have absolutely no pride of manufacture." [Vol. I, page 388.]

He believed any incumbent in a position should not try to make himself indispensable, but should train others to fill his place.

> "The writer is quite sure that in his own case, as a young man, no one element was of such assistance to him in obtaining new opportunities as the practice of invariably training another man to fill his position before asking for advancement!" [Vol. I, page 140.]

Though often accused of pace-making, which threatens the health of workers, he was, on the contrary, very solicitous for their health. The only pace he sought to make was that which was best for all concerned. As to the stop-watch myth, Taylor said:

> "Somehow there has come to be an impression . . . . that for every workman who is working in the shop there are probably four or five men standing over him year in and year out with stop watches . . . . There are many workmen who never have a stop watch held on them. And probably the average man would not be timed for more than one day in his lifetime. So that probably one day of the workman's life would sum up the total of this terrible, nerve-racking strain which several of the men who have testified . . . . have complained of." [Vol. I, page 234.]

One of his ideas which, if generally adopted, would promote the health of women in industry he expressed as follows:

> "All young women," he wrote in the *Principles* [page 96], "should be given two consecutive days of rest (with pay) each month, to be taken whenever they may choose." [Vol. I, page 464.]

Taylor was one of the first men in industry to combat the drink evil systematically.

> It is said that as early as these Midvale days of his he predicted the triumph of prohibition, and that it would prevail not so much for moral reasons as economic. . .
>
> "In other cases we induced them to sign a pledge for a year, and time and time again, just before the year was up, we went to these men and induced them to sign again for a second and third year.
>
> "The result of this was that in a few years drunkenness was practically eliminated. [Vol. I, page 178-9.]

Creative Instinct

Although Taylor's main effort toward spurring on the workman was confined to arranging more effective financial rewards, it is interesting to note that his own motivation was not primarily that of a money maker.

Like the older economists who assumed the existence of "the economic man," a purely selfish being, Taylor assumed that his task was to appeal to selfishness. Yet both he and the economists belied the theory.

My own revered master in economics, Professor William Graham Sumner, built up his economics on the money-making instinct. Yet he himself was motivated primarily by the love of science for science's sake.

A similar incongruity is exhibited in the life of Taylor. He too founded his system primarily on the idea of the money-making motive. Yet he, like Sumner, was motivated quite otherwise.

> We believe, in fact, that his life's *leitmotif* is to be interpreted in terms of the counterplay in him of these two forces, the one impelling him to discover and invent, the other to make his discoveries and inventions serve the interest of society. And as we follow him through his life, we perchance may catch the echoes of a noble, if largely unconscious, self sacrifice born of this counterplay of forces. On the one hand, he longed for the peace and quiet of laboratory and study and the happy companionship of congenial souls; on the other hand he was impelled to go out and fight to bring things to pass, so that his innately gentle spirit got all scarred up. [Vol. I, page 44.]
>
> He seemed to count that day lost whose low descending sun viewed from his hand no novel action done. [Vol. I, page 333.]

The creative instinct was strong within him.

> "I think there is no greater pleasure to a man of inventive faculty than exercising this faculty." [Vol. I, page 426.]
>
> Looking back, he always found that the big thing was the accomplishment. [Vol. I, page 427.]

Taylor's last years were dedicated entirely to the work of spreading his gospel. He took no pay, but on the contrary paid salaries to young men to learn the system.

> When he left the Bethlehem Steel Company, he had accumulated a competency which sufficed to make him feel, with his prejudices against great wealth, that he no longer could afford to work for money. [Vol. I, page 393.]
>
> The shrewd Yankee in him came to recognize that few things would so much help him in promoting his cause as the knowledge, discreetly diffused, that in this educational work he had no money interest whatever. [Vol. II, page 167.]

Even when working at a lathe, Taylor was motivated by interest in the product. He said:

> "I worked the same hours as the other workmen, and I tell you it was the easiest and happiest year I have had since I got out of my apprenticeship—that year of going back and working on a lathe. I worked hard from the machinist's standpoint and harder than I had ever worked before in my life as a mechanic." [Vol. I, page 433.]

We may guess that his happiness in those years was not appreciably due to any bonus or piece rate or other appeal to his acquisitive instinct! Yet he never seemed clearly to realize that other workmen needed the same sort of interests in workmanship to be happy at work. Like everybody else they need to satisfy all the fundamental instincts of human nature. The Taylor System, after all, harps chiefly on one string, the instinct of self preservation. A complete life must satisfy many other instincts, such as the instincts of workmanship, self-respect, home making, reverence, loyalty and play. These are among the things men live by and not by bread alone. There is an example of workingmen attracted back to Bethlehem from Pittsburgh by the higher earnings they got under the Taylor system. But it is clear also to anyone who reads between the lines in Copley's vivid account of this incident that, combined with that money making motive, were the motives of workmanship and self-respect. Mr. Barth tells me of another case where non-monetary motives were uppermost.

> "While I was with the Link-Belt Co., a 'drill press hand' who had left for some trifling grievance, came back, giving me as his reason that the drill-press he had been given to run was so underspeeded that the fastest speed was not half enough, and that, having learned what constituted proper speeds, he could not stand it, day after day, to run so slow. Similarly a 'boring mill hand' who left because he had been transferred to the night gang, came back, giving as a reason that he could not stand hanging around the tool room for an hour or so to get a boring cutter made for every special job, after he had worked in a place where the cutter was always delivered to him beforehand. These are, I think, good early examples of the character building effect of scientific management."

Team Work

Taylor's dream was of harmonious team work between capital and labor.

> That indeed was the object of most of his luncheons and dinners—to bring workingmen and other men together, and so fill in the social chasm that usually exists between such men. [Vol. II, page 437.]
>
> The appeal to class consciousness and to class interests and the stirring up of class hatreds and class warfare was to him a thing accursed. [Vol. II, page 423.]

His ideals were the democratic ideals of Abraham Lincoln. He practiced and preached the simple conventional virtues. His biographer records the fact that he found in Taylor's youth "no problems of indiscretion" to embarrass him.

Many of Taylor's followers and admirers were also conspicuous altruists, including Barth, Cooke, and Brandeis, now of the Supreme Court, formerly "the people's lawyer."

Taylor's Swearing

His only vice was one of which he was proud—a virtue rather than a vice—to him, at least—and that was swearing. He made swearing a fine art, believing, apparently, with army officers, that it was an important means of discipline. To that extent his system always remained a "military" one.

Psychologically, swearing is justified as an outlet for the emotion of anger. But in the ideal psychology no outlet is necessary since the emotion itself is absent. It is a sad commentary on the pent-up feelings among foremen and men that swearing is so common in industry. Were Taylor living and still studying his favorite problem of labor contentment he would surely be immensely impressed by the observation of "Golden Rule Nash" that under his regime swearing tends automatically to disappear simply because the inner feelings of resentment and irritation disappear with the observance of the golden rule.

Taylor Too Serious

Taylor took life seriously—very seriously indeed. Even his sports came to be regarded as a duty. He wrote:

> "For me, however, I find it many times exceedingly irksome to give up the intellectual work in which I am at the time very greatly interested, and go out onto a dreary golf links to spend two or three hours chasing after a golf ball. For me this medicine is frequently as bad as to go to the dentist; and yet when I once get out on the links and begin my exercise in the open air, somehow I lose my disgust and begin to cheer up and profit by the complete physical and mental change. Personally, I feel as if I need a guardian a good deal of the time, to lay out my day's work for me and keep me from doing too much of the nerve-racking kind." [Vol. I, page 454.]

Again we read:

> ". . With . . onerous golf duties, my time has been more than full." [Vol. II, page 391.]

He experimented with the best golf strokes and developed unheard of methods, which, judged by tradition, were far from "good form."

> It is said that the emotion aroused in a stranger by Taylor's stance and stroke at driving was as nothing compared to the emotion that followed when this same stance resulted, as it often did, in a 250-yard drive. [Vol. II, page 220.]

Taylor Personally

At home, however, Taylor really cast aside his business cares and even avoided talking shop with his family.

> He not only invariably shielded his wife from worry, but acted in every relation on the principle that it was for him to share his joys abundantly while he bore his troubles alone. [Vol. I, page 389.]

When once, in Maine, he tested a saddle horse for his wife—

> He rode the horse, not only in the side-saddle his wife was to use, but in the skirt borrowed from her. It is easy to imagine the awe with which the natives viewed this action by the city man; but, Lord bless you! appearances never concerned Fred Taylor. [Vol. I, page 374.]

When the war came its horror nearly crushed him. His life work had been constructive *par excellence*, while war was destructive *par excellence*. He wrote friends:

> "This war is inconceivably horrible. I am completely upset and unnerved by it, and can think of nothing else. . . . ."
>
> "To me the whole thing is absolutely unthinkable. I lie awake at night worrying over it, ..." [Vol. II, page 443.]

Like so many reformers he came to feel the weight of the whole universe on his shoulders. He could not bear to see things go wrong.

> Seemingly his philosophy had one grave defect. Throughout his life he was inclined to take too much upon himself, to assume and to feel too great a responsibility. He did not leave enough up to God. [Vol. II, page 438.]

Taylor's Fame

Frederick W. Taylor has made a unique place for himself in history as one who bridged the gap between science and industry, between theory and practice. The world owes him at least undying fame for his accomplishment in replacing guesswork by science and thereby adding immensely to the wealth and welfare of all mankind. Some day even labor may canonize him as a patron saint.

COPLEY'S life of the "Father of Scientific Management" has been in preparation almost from the time of Frederick W. Taylor's death in 1915, a period of nearly 9 years. It is now in our hands as one of the vital books of the immediate present.

The author set out to write the biography of a great man. This he has done and done well, but he has also done much more. He has answered for us affirmatively, the question—Was Taylor, the man, as great as his work?

Further, the book is the story of the origin, development, and nature of scientific management and the Taylor System, and incidentally a portrayal and interpretation of an upheaving American industrial epoch, 1880-1895.

As an intensely human story of life in industry it will be read and reread, as an exposition of management in its historical setting it will be referred to and used again and again. Nothing but good can be said of the general treatment adopted by the author. Candor and impartiality are prominent characteristics, for both the weakness and strength of the man are portrayed. The selection and grouping of material have produced an interesting narrative. This has been possible for the subject was a man who was earnest, vehement, and combative, who lived amid struggles and controversies, many with dramatic settings equal to the plots of virile fiction. The gift of interpretation has been freely used. Not only are events narrated but their meaning and significance are inquired into. All in all it is an outstanding example of research and authorship.

Because of the immensity of the task of reviewing the life of a man who did a prodigious amount of work, it is not surprising that some few incidents and statements seem out of proportion or even presented in an erroneous setting. It may even be felt that they throw the real excellence of the biography into higher relief. . . .

As the last word is read and the book closed possibly the most lasting impression is that of the stupendous task attacked by Frederick W. Taylor. In magnitude and complexity the organization and management of industry can only be likened to the organization and administration of government. The latter has had centuries of development and improvement; Taylor elevated the former to a science in the brief space of 30 years. (L. P. Alford in *Management and Administration,* March, 1924.)

658.
658.92

Taylor's Intellectual Contribution[1]

Consistent Use of the Scientific Method in Management— Tangible Procedures to Make Management Scientific

By ORDWAY TEAD
New York School of Social Work[2]

THE significance of the intellectual contribution of Frederick W. Taylor is out of all proportion to any recognition it promises to get. Not only was this man widely misunderstood during his life for reasons for which he was in part to blame, but his subsequent recognition is negligible as compared with the actual influence exerted by his ideas in all sorts of places where his name has never carried.

Frederick W. Taylor (1856-1915) lived in the generation which was developing the industrial resources of the United States and was necessarily developing them with the employment of personal qualities and characteristics which were essentially of the pioneering sort. His lifetime saw the growth of industry immediately after the Civil War from small units to the consolidation and nation-wide combinations of recent industrialism. It was the period which saw develop in acute form the conflict between organized owners of capital and organized labor; and saw it increasingly recognized that, in the enormous increase in wealth brought about by the industrial expansion of the latter half of the nineteenth century, the position of the manual worker in the scheme of things did not appear to be commensurately advanced.

It was characteristic of this pioneering that the sources of profit should be viewed extensively rather than intensively. Characteristic also that the financial interests which were in that day involved in industry should be absorbed with balance sheets and stock quotations and be concerned not at all with the requirements of what we today speak of as fundamental operating efficiency.

In such a period the preoccupation of a young engineer in the intensive application of human energy to individual industrial jobs was not calculated to be popular. Indeed, the fierce opposition which Mr. Taylor encountered in the early years of his efforts to get a scientific point of view inculcated in the minds of managers with whom he was actively associated, is probably the explanation of the vehemence and the arbitrary method of statement with which so many people came to associate his name. For the record of Mr. Taylor's fight with his superiors and his subordinates at Midvale, together with his later experiences at Bethlehem, constitutes a story of ruthless opposition and stupid inertia on the part of managers, and sullen obstinacy on the part of manual workers. No one but a man who conceived his task in terms of world-wide importance would have stood up against the treatment he received. In fact, in the fascinating biographical narrative which Mr. Frank B. Copley gives, there is no obvious explanation for the motives which kept Mr. Taylor at his original project. If it is a characteristic of greatness that the genius is borne on by an inner urge which seems to have no rational causal connection with immediate conditions, Mr. Taylor certainly qualifies among the great.

Mr. Copley does show clearly, however, the intellectual genesis of the group of ideas which have come to be known by the name of scientific management. And it seems to the reviewer a matter of profound significance that the conditions which started Mr. Taylor's mind working in its lifelong direction are still providing the main and central occasion for conflict and misunderstanding between manual workers and the rest of the community. This fact indicates how penetratingly Mr. Taylor went to the heart of the management problem on its human side. In a word, Mr. Taylor, because of his years of experience as an apprentice and manual worker, became convinced that the manual laborer was not doing in a day the amount of work which might fairly be expected of him. The impetus to his whole inquiry into managerial methods lay in his profound irritation at this condition of what he believed to be wholesale soldiering.

---

[1] Reprinted by permission, from *American Review*, July-August, 1924. The caption is ours.

[2] Co-author with H. C. Metcalf of "Personnel Administration: Its Principles and Practice"; author of "Instincts in Industry."

That he confronted this problem wisely will be realized if it is stated that today, thirty years after Mr. Taylor's contributions to management theory began to be made, the only plants or industries which are on the way to coping with the problem of securing a fair day's work are those which are utilizing the essence of the methods which he evolved.

It would be a mistake, however, to give the impression that Mr. Taylor viewed the problem of manual workers' reluctance to give a full day's work as one created by the workers or one for which they were themselves primarily to blame. The emphasis of his subsequent teaching always was that the utilization in the most effective way of the energies of the workers of an organization was a responsibility which required in a peculiar and in a wholly new way the use of the intellectual resources and working capacities of management. Indeed, Taylor found himself opposed repeatedly not alone to managers but to the banking and promoting interests. His disgust was outspoken with financiers whom he found interested only in profits which were quick and easy. Although on certain occasions he was fond of saying that the interests of the employer and the employe were identical, he also did not fail to point out in a number of cases, and with considerable vehemence, that the employer who had his eye on dividends alone was not in a mood to sympathize with the principles, methods and results for which he stood.

Looked at in retrospect, the birth of the ideas of scientific management seems obvious and logical enough. It started with the desire to have manual workers do a fair day's work. What, then, is a fair day's work? It is not simply the amount of work which is being done or even that which has been done by the faster workers. It is rather that amount of work which a reasonably rapid and conscientious worker can do without undue fatigue when he is trained to employ those methods and motions which after careful analysis and experiment are found to be the most expeditious and the most economical of time, energy and material. The determination of a fair day's work is thus to a considerable extent a matter for painstaking scientific inquiry—for thorough-going job analysis.

But such thorough-going analysis quickly reveals the fact that the maintenance of the machine equipment must be carefully provided for in advance; that the kind, quality and amount of raw material or parts to be assembled must be of a reasonably uniform and standardized character; that surrounding shop conditions in point of light, ventilation, humidity, etc., must be good. In other words, no statement can be made regarding a fair day's work at a given job that will hold true after the study has been made unless the surrounding conditions in terms of equipment, materials, and working conditions have also been brought under control and standardized. This at once leads to the building up of a procedure for the functionalizing of certain shop activities and for the controlling of the whole process of design, flow of materials, etc. And thus gradually evolved the whole procedure of planning, scheduling, routing, follow-up, and costing, which forms the nucleus of the technique of scientific management, so far as internal shop operation is concerned.

The development of an adequate technique to assure this systematizing and standardizing of procedure was merely a matter of time. And although the number of plants which during Taylor's lifetime or since have introduced this procedure in its entirety can probably be counted on the fingers of two hands, yet the fundamental notions of standardization of procedure, centralized control and functionalized staff departments, have come to be widely accepted as elements without which a management science would today hardly be conceivable. It is in this sense that the significance of the contribution of Mr. Taylor cannot easily be over-rated.

Management must always be both a science and in its application an art. And in so far as it is a science today, it owes more to Frederick W. Taylor than to any other one mind, both for the point of view and for the method which he urged. He became the apostle of the consistent use of the scientific method as applied to management, and he offered a body of tangible procedures that would make management scientific; and he thus became the initiator of what he rightly insisted was a revolutionary way of looking at the management problem.

On Taylor's contribution in the field of mechanical invention it is of less importance to dilate, although his creative talents were throughout his life turned toward the offering of inventions which were in the aggregate a distinct addition to the sum of human knowledge.

Much has been written and much is said by Mr. Copley, regarding Taylor's philosophy. In any strict sense of the use of that word, Mr. Taylor was not a philosopher. He had the training of a mechanical engineer, and it was with considerable struggle, so his biographer tells us, that he was ever able to formulate in written expression precisely what he wanted to say. This would naturally mean that when he tried to formulate his views in the more general field of the relations of capital and labor, the meaning of trade unionism, the place of the employes in the control of industry, the problem of allocation to different groups in society of parts of the annual national income,—that he should state himself in terms to which the economist or the social philosopher might take exception.

Nothing is clearer in the light of the biography than that Taylor was far from being his own best elucidator. Unquestionably he alienated many who have since come to appreciate the importance of his essential contribution. Indeed, his whole relation to the organized labor movement and its possible interest in the question of a fair day's work was most unfortunate, although it is easily understood and explained in the light of this volume. One of his friends rightly said of him that Taylor had "a very intense temperament." He was a man of extraordinary physical and nervous energy. He was one of those who believed in working with great intensity while he worked, and he saw so many intellectual challenges and opportunities for creative thinking in work that the motion of labor as a task was foreign to his nature. Also, as an engineer, his method of statement gave great prominence to "facts"—the tacit assumption being that all facts were as objective and as provable as a problem in physics or chemistry. Thus the question of what was a fair day's work was to him a question of "facts." And that there was any opportunity for opinion to enter here was not admitted. However, many of the objections which were raised by publicists and by trade union leaders to Mr. Taylor's proposals and methods were made without adequate understanding of their real nature. And no doubt his manner of utterance frightened some of these very opponents away from a serious attempt to understood what he stood for.

As Mr. Copley wisely points out, the real and central issue that remains out of all the intellectual controversy stimulated by Mr. Taylor's utterances on the broader issues relates to one topic. It is the question of the inevitability of conflicting interests arising as between owners and manual employees in the distribution of the income from industry.

On the subject of trade unionism Mr. Taylor's utterances show him on the whole to have been reasonably understanding and tolerant,—at least in theory. (The biography does seem to supply evidence, however [p. 428], in support of the contention that the idea of collective negotiation with either unions or shop committees became increasingly repugnant to him as he grew older.)

As to the value of defining a fair day's work as scientifically as possible and of insisting that this scientifically-determined standard be lived up to, opposition was at first widespread in the trade union world. Today there is an increasing body of organized labor opinion and practice in favor of precisely this. But when Taylor argued that because workers and owners were equally interested in low unit costs,—which is true,—they were therefore not in conflict as regards the distribution of the net returns from the business as a whole, he saw things from a point of view with which many economists do not agree. Mr. Copley on this point introduces a footnote which deserves attention. He says:

> As we understand it, the friends of Taylor who here opposed him were also influenced by this consideration, which they hold to be a fact: That while Scientific Management has discovered laws of production, it has not discovered laws of distribution, and this being so, the only fair way to determine what shall be labor's share of the profits of production is by conference.

This review will inaccurately represent the breadth of Mr. Copley's study if it fails to appreciate the effective way in which Mr. Taylor's personal life is depicted. The biographer provides a splendid balance in the treatment of the man's life and of his ideas. As a matter of industrial history, these ideas in their inception are not to be understood apart from the man's life; although it remains true that any assessment of the value of his ideas as they are today found in action must be made on a basis of their own intrinsic merit. Unquestionably time has brought a gratifying measure of balance and corrected proportions into the popular understanding of the essentials of scientific management doctrine and practice. And the essential kernel of these ideas, apart from the personal peculiarities of the vigorous engineer who first gave utterance to them, is being more and more recognized by all groups in industry.

Mr. Copley's work as biographer has been done with remarkable skill, discernment and sympathy. The work of a man like Mr. Taylor was carried forward with the assistance of a few remarkably loyal men faced with universal opposition. The very intensity of devotion required under these circumstances might easily have led the sympathetic biographer to have taken the view of the ardent disciples, who were probably largely instrumental in giving the world this book. Mr. Copley has fortunately kept himself free of this fault, and has presented frailties and shortcomings in a way that has added greatly to the strength and poignancy of the picture as a whole.

It is to be regretted that the biography is forbidding by virtue of its length. And it might well be argued that a greater educational service would have been rendered by cutting it down to a book of nearer 600 than 900 pages. But the serious student of management history will find the text sufficiently absorbing to offset this drawback. Certainly no one can hope to understand the intellectual situation in the modern profession of management without having the background which this book so splendidly gives.

In certain quarters the name of Taylor is unfortunately still synonymous with the exploitation of manual workers in terms of speeding up, wage rate cutting, monotonizing of jobs, and the like. But the honest reader of this biography becomes convinced that, if the cause of industry conducted as a public service for the benefit of all the workers and the consumers no less than the owners ever had a vigorous champion, it was Frederick W. Taylor. He was not given to indulging in rhetoric on this point, but *obiter dicta* throughout his life clearly indicate that he not only had no patience with exploitation, but was definitely interested in a well-distributed prosperity which he rightly conceived to be based on an abundant productivity. Mr. Copley succeeds brilliantly in making the reader feel that Taylor modestly but forcefully added to the sum of our understanding regarding managerial science in dimensions that will cause future generations to rise up and call him blessed.

OUR thinking on industrial subjects would be enormously enriched and might be correspondingly improved by the addition to our literature of a large number of competently prepared biographies of leaders and of craftsmen in the industrial world. The need for such a type of biography has been particularly great in the case of Frederick W. Taylor. This is true not only because he has contributed more than any other to the professionalizing of industrial management, but because the bluntness and brevity of his speech and of his writings and their concentration on specific problems of shop management left little space for the personal factors and historical setting so essential to a true interpretation of Mr. Taylor's work and contribution. Mr. Taylor has needed a Boswell—in Copley he has found him . . . .

In the preparation of this interpretative biography, Copley has built upon his intimate acquaintance with Fred Taylor's work by an exhaustive examination of the literature of management and of Taylor's writings and correspondence in particular. Material has been carefully assembled by interview and letter from a long list of persons who had worked with Taylor or who had had an opportunity to know of Taylor and his work or of the setting in which his life was lived and his work done. By this careful collection of material a great service has been performed for all students of industry and for students of scientific management in particular. Both Mr. Taylor and his work will be better understood, better appreciated, and more widely known on account of Mr. Copley's work . . . .

One of the fine things one gets from the book is the picture of Fred Taylor, the man. Existing writings could leave readers who were unacquainted with Mr. Taylor personally with the impression that he may have been either a divine paragon or a driving boss with a relentless will. It remained for Copley to make Taylor human to strangers, to bring out his humor, his kindliness and sympathy, his spirit of human service, as well as his inexorable scientific spirit, his iron will and his Puritanic sense of duty that led his acquaintances to say "to tell Fred Taylor anything was impossible was just about the one best way to stimulate him to go after it." (Joseph H. Willits, in *American Economic Review,* September, 1924.)

658.
658.92

An Authentic Genius[1]

A Picture of Taylor to Excite Both the Romanticist and the Psychologist

By **STUART CHASE**
Investigator, the Labor Bureau, Inc., New York City

A BOY of twelve was troubled with nightmares. He devised a harness of straps and wooden points which automatically awakened him when he turned on his back. In playing croquet, it was the boy's habit to study the angles and velocity of the various shots, while his elders were content merely to hit the ball. When he walked across country he continually experimented with his legs in order to discover the step which would cover the maximum distance with the minimum energy. Years later, having been told by expert horticulturists that trees and hedges above a certain size could not be transplanted, he promptly developed a technique for moving box hedges and large pine trees which proved the horticulturists to be quite ignorant of their own business.

For the Midvale Steel Company he built a steam hammer which stretched the laws of physics, though it proved the mightiest hammer ever designed, and he built an extraordinarily efficient chimney like the tower of Pisa which men swore would fall down, but which did not fall down. For a paper mill he devised a hydraulic yanker of logs from stream to factory floor; he put his bark strippers in cages safe from dangerous machinery, and he cut the cost of sulphite pulp from twenty dollars to eight dollars and fifty-eight cents a ton. But it took him fourteen years to learn that "the best measure of the value of a tool lay in the exact cutting speed at which it was completely ruined at the end of twenty minutes." In the recesses of his mind, he kept a private chamber of horrors. In it were Germans, theologians, trade unions, politicians, professors and financiers. In brief, Frederick W. Taylor was that relatively rare human being, an authentic genius.

He was born in Germantown in 1856 of well-to-do parents. His father was of Quaker, his mother of Puritan, ancestry. He tells us that he inherited "a whale of a New England conscience." He prepared for Harvard at Exeter, but never matriculated because of his eyes. He entered the works of the Midvale Steel Company in which his family was financially interested, as an apprentice. He worked as laborer and machinist, was promoted to foreman, and at length became general technical advisor, having meanwhile qualified as a mechanical engineer at Stevens Polytechnic. Stevens taught him the principles of mechanics but the narrow engineering training was not a happy medium for the free flow of his genius. At Midvale, he laid the foundation of his system of scientific management as a sort of by-product in connection with his work on cutting steel. As an inventor, he revolutionized the art of high speed steel cutting, and for this achievement alone would have won lasting fame. But it was the by-product that ultimately came to claim first place in his heart, and it is for this by-product that he will be chiefly remembered. Inventions in technical processes had been happening regularly for a hundred years. The technique of scientific management was something new in the world. He left Midvale to become a consulting engineer in the new profession, and introduced his methods in many great industrial concerns, as well as in government arsenals and navy yards.

Sometimes he was successful, sometimes he failed, being unable to bring about that "revolution of thought" on the part of the management which was cardinal in his system. Always he was headlong, imperious and tactless. A very demon of a man, the stronger because he knew his facts, while his opponents dealt largely in hearsay. If Spencer's idea of tragedy was a theory killed by a fact, Taylor's idea of tragedy was a fact killed by a theory. He became President of the American Society of Mechanical Engineers, but he was a relatively unknown man until Brandeis tranfixed the country with the news that the railroads were wasting a million dollars a day. This charge was based primarily on Taylor's work, and the work of engineers who had followed Taylor. Following the famous rate case, "Taylor efficiency" (a misnomer as we shall see), and "Taylorism" became almost as well advertised as "Einstein" today—and about as well understood. And ever since, his name and his work have moved in storm and fury and adulation. During the latter part of his life (he died in 1915) he devoted himself to extending the knowledge and application of scientific management without financial remuneration of any kind. For this work he often drew heavily upon his private income. There is no question but that he was utterly sincere in regarding it as a solution both of the problem of capital and labor, and of underproduction. He hated trade unions, but he lived and died in the belief that the outstanding sanction for his method was that it would lead the worker out of bondage. Beside this goal, profits and production per se took a secondary place in his mind.

---

[1] Reprinted by permission, from *The New Republic*, October 8, 1924. The caption is ours.

Mr. Copley has had no light task in telling the story of this extraordinary man, and on the whole he has done a remarkably good job. These two volumes will never rank as one of the world's greatest biographies, but from them we get sound, technical insight into what Taylor did, and a picture of the man himself which can excite both the romanticist and the psychologist. The tempo is seldom heroic, adulation is mercifully absent, the cracks in the armor appear as well as the brave shield and buckler. It is recorded for instance that when Taylor debated his theme before a Congressional investigation committee, he so completely lost his balance that his ravings had to be stricken from the record. And while he regarded all the taboos of the great American home, his opinion of the church was largely unprintable, and he was a past master in the higher profanity. The author has greatly increased the value of his book as a human document in thus avoiding the usual biographical glucose.

But perhaps even more important than the personal story, is the attempt to get into focus the movement which Taylor launched on an unwilling world. What was this thing—this "scientific management" that the builder of corkscrew chimneys forced down the throats of angry executives, that caused Mr. Gompers' remaining hairs to stand on end, that filled the pages of the newspapers in 1911 until "efficiency" became a national slogan; that translated this man's ill-written books into a score of foreign languages, that founded the Taylor Society, that laid the university by the ears, and at last raised him to the dais of an engineering saint before whom men bowed down and worshipped? What did Taylor discover? What has scientific management done to our behavior and our thinking in the generation which has grown up since "On The Art of Cutting Metals" was first published?

Taylor or no Taylor, scientific management would have come. Perhaps not so soon, perhaps not so concretely, perhaps more tactfully, but it would have come. Back of Taylor were Babbitt and Sellers, and a certain Frenchman who in 1760 was time-studying the process of pin making. The growing scientific spirit would have forced a critical analysis of management and industrial planning. We have not here so much the shadow of a great man, but a genius loose in a gathering shadow.

What Taylor did was to apply scientific methodology —as opposed to trial and error—to the job of making up a given amount of raw material into given finished product, on the principle of a minimum of waste and friction. To accomplish this end it became necessary to analyze every factor in the circuit, to bring to bear the last word in technical knowledge, and ultimately to set up performance standards. If the job was making locomotive tires, the raw steel, the cutting tools, the arrangements of cutting machinery, the belting, the power load, the lubricating and cooling devices, the handling of supplies, and the physical motions of the men who ran the tools, must all be analyzed and coördinated by hundreds of laboratory experiments until the best way was found. (In his high speed steel work, Taylor conducted no less than 40,000 experiments.)

The basic principles as stated by Taylor include: first, the development of a science for each element of a man's work, to replace the old rule of thumb method; second, the selection and training of workmen to follow the science laid down; third, the payment of extraordinarily high wages to workmen who approached the standard performance set up, and of ordinary wages to those who took more than the standard time allowance; and fourth, the dividing of responsibility between men and management on the basis of scientifically determined function.

Time study is not scientific management; piece work is not scientific management; "efficiency" is not scientific management. Scientific management goes to the root of the problem in hand and sets up a 100 per cent standard, based if you please on a certain amount of time study, and piece work rates. It is the *best* way of doing the job on the basis of extant technical knowledge. "Efficiency" on the other hand has to do with tinkering and patching, and, if it is lucky, finding a *better* way than the reigning one. Scientific management, as Taylor insisted over and over again, implied a mental revolution in management and men, and often a physical revolution in plant. It meant functional instead of military shop organization, a central planning department, higher overhead costs to gain lower direct costs; it meant turning the works into a laboratory for a greater or lesser length of time, suspending production, rebuilding, rearranging, educating labor in new habit patterns; it meant increased capital outlays, no immediate profits, deferred dividends. It meant in brief doing the job right.

The rage of "practical" executives under the circumstances is perfectly understandable. They are raging still, but on the whole the clamor grows less. As Taylor's followers—men like Gantt and Thompson and Cooke—carry on, and, it must be admitted, modify and amend, a steadily increasing number of concerns, both here and abroad, are coming in whole or in part to an adoption of the principles of scientific management. The "mental revolution" grows.

Scientific management will endure, for it is not built on sand. But it will need important modifications in its approach to the worker. With the unions Taylor fought a pitched battle to the day of his death. As a result the two words are anathema to the average laboring man. There is no complete system of scientific management in any union shop. Taylor was not a philosopher. He never glimpsed the very real factors implicit in the struggle between owners and workers. He believed with a charming logic that labor and capital were cooperators and should act as cooperators. He never saw the bitter agony and the stark necessity out of which the labor movement was born. He never took into adequate consideration the phenomenon of businesslike sabotage on the part of an absentee owner. In brief he was no economist, no psychologist, but an excellent engineer looking at the social ellipse with all the impatience of a mind which moves in straight lines. Some method accordingly must be found for reconciling the labor movement to scientific management based on more than "extraordinarily high wages for 100 per cent performance," before the movement can secure the headway it deserves.

In the locomotive repair shops of the Baltimore and Ohio Railroad, the International Association of Machinists and the shop crafts unions, in cooperation with the management, are now conducting an experiment which may provide the technique for healing this breach. In this experiment the unions have retained their own engineer, Mr. O. S. Beyer, Jr., and under his direction the men are taking more responsibility, and giving more intelligence and interest than was ever contemplated in Taylor's original plan. And not the least interesting phase of the experiment, is that it is being conducted by the very union which fought Taylor the hardest! The hue and cry which has been raised as to the disastrous effect on the worker in respect to "speeding up," monotony, fatigue and the "dead level of uniformity," leave us unimpressed. Taylor repeatedly held that if the standard set up made for over-fatigue, the planning department had bungled its job. Scientific management, he said, did not become genuinely scientific, until men were content to work under it. This was a cardinal principle in Taylor's mind. Granting machine production, it is difficult to see how Taylor's position can be attacked on this score. There is little possibility of craftsmanship, there can be little release of the creative instinct in machine tending. Better to face the fact unsentimentally, prescribe the habit patterns which will give the maximum of output with the minimum of fatigue, and trust to an ultimate shorter work day to right the outraged biological balance. In other words this particular attack on scientific management turns out to be an attack on the machine age in general—which is another story.

Finally it must be remembered that while scientific management provides a most admirable technique for the elimination of waste, and has great promise in the direction of increasing production and real wages therewith, it is not yet yoked up to any such social goal. It is concerned solely with speeding up the output of a given product—whether that product be whole wheat flour or Tono Bungay. It has the potentiality of all these things, but it has equally the potentiality of increasing the fixed charges of industry on the wayfaring man. Like Giant Power, it comprises a sound and magnificent technique, but it is a technique which may be used either for liberation or exploitation. And so far as the record runs, no man can yet say whether it is liberation or exploitation which will prevail.

658.
658.92

Taylor the Creative Leader[1]

An Analysis of Taylor's Contribution to the Problem of Human Welfare

By **OLIVER SHELDON**
Organization Manager, Rowntree & Company, Ltd., York, England[2]

"THE HISTORY of the world is but the biography of great men," said Carlyle. "For, as I take it, universal history, the history of what man has accomplished in this world, is at bottom the history of the great men who have worked here." In that work of the world every man has his share, and more intriguing than any novel, more emboldening than any romance are the stories of the share which this man or that man has taken. "We cannot look, however imperfectly, upon a great man, without gaining something by him," continued Carlyle; and Frederick Taylor himself echoed the same thought,—"I think no book is more stimulating than the history of a devoted and successful life."

This thought of Frederick Taylor is mine as I read Frederick Taylor's own life.

I turn over the last pages of this book, and, as I read of that simple grave on a hill, above the Schuylkill River, I try to sieze upon my main impression. Through many pages I have followed the growth of a man and of a movement. I have seen childhood, youth and manhood; work and pleasure; difficulty and success; home life and public life, in the story of one man. I stand where this buoyant, restless, indomitable stream runs into the inscrutable sea, and I look back. I trace it from its source in Germantown. I see it widening and deepening as it flows through Midvale and Bethlehem and anon the pleasant greenery of Boxly, till it meets the incoming tide. I try to weld my chasing thoughts into some unifying impression, and it is this—that, in the intimacy which these pages have afforded me, I have been treading a pathway in the rare company of the man who hewed it out—a footpath broadening into a highway which leads on further than the lights of this mortal city of mine. I see a man building a road, and the road outstrips all sight. Some men are great, for the fruits of their work are spread for all the world to applaud. Frederick Taylor is great, for the fruits of his work have yet to be garnered. The potentiality of it all is what strikes me most. The greatness of a man is normally associated with the movement in which he played a leading part. Great as was Frederick Taylor, greater still is the movement of thought which he has inspired.

I have seen a purposeful and tenacious mind toiling, through the hard school of experiment and the clanging uproar of day-to-day living, towards a philosophy of which it was not yet aware; I have seen it boldly developing systems which gave that philosophy an actual, workable life; I have seen it pounce upon the various facets of that philosophy, as the light glinted from the stony surface of reality and revealed a principle; I have seen each facet, each principle fitted into its place, like the pieces of a mosaic pavement—and the philosophy is greater even than the thought of him who pieced the stones together. As the philosophy of Rousseau, in the body politic, was greater than Rousseau, so is the philosophy of Taylor, in the body industrial, greater than Taylor. It is, indeed, the privilege of great men, the pioneers and builders of human thought and progress, to be immersed in the movements which they have originated or furthered.

It is well, however, that we should, from time to time, fight our way back to the original work and constructive effort of those who have done outstanding service in any field of progress, that we may know and admire the source of that which we inherit. For, if a great movement is greater than the life of any who served it, yet does such a life inform the movement with something tangible, and bring it within the compass of every day affairs. No great movement but has its great men, and in their lives are hidden the keys which open the doors of understanding. Philosophies are intangible; men are real. The life of the man brings the philosophy closer to the things we know, gives it substance, makes personal the impersonal. And truly the life of Frederick Taylor, while opening a wonderful vista, in the very ruggedness of its story makes the philosophy essentially work-a-day.

---

[1] Reprinted from *Bulletin of the Taylor Society,* Vol. IX, No. 1, February, 1924.

[2] A. B. Oxford; author of "The Philosophy of Management."

Mr. Copley has achieved a remarkable work. He has faithfully and picturesquely recorded the life of Frederick Taylor, yet at the same time has presented like a panorama, the growth of a philosophy, of which Frederick Taylor was the leading artisan. While he traces the life of Taylor to that stone memorial on a hill, which stands for all that mortal frame endured and conquered, he makes us see the contribution of Taylor to human thought as a stage from which the curtain is but half withdrawn. Of the life, the tale is told; but of the philosophy, the play has barely begun. In this, Mr. Copley has succeeded in an immensely difficult task. Rarely has a man, either in fact or in popular thought, been so closely associated with a movement as was Frederick Taylor with scientific management. Rarely has a man lived to see the growth of definite principles out of his own groping experiments as Frederick Taylor saw the principles of scientific management emerging from his work at Midvale and Bethlehem. Rarely has a man lived to bear upon his own shoulders both the praise and the execration accorded to a new movement of thought as Taylor in his own lifetime did. Rarely have the name of a man and the name of a movement been so readily interchangeable and in fact so actually interchanged as the names of Frederick Taylor and scientific management. Yet, in spite of the close and personal relation between the man and the movement, Mr. Copley has succeeded, while treating the man and his work as a whole, in distinguishing between the two, and leaving us distinct impressions of each. The sun of the man has sunk to its inevitable setting, but the sun of his philosophy has but barely broken the clouds in its dawning. To write the biography of such a man is no easy task. It cannot be just the bare record of a man's life and what he did. It must give that, and more, for what he did was not something which ended with himself. The task of the biographer was not only to tell a life-story, but to relate that story to what was yet to follow—to trace the fleeting life to its premature close, whilst its philosophy was waxing to its springtide. This Mr. Copley has achieved with singular success. He has given us a living picture, with all its lights and shadows, of Taylor, the man; and a wise survey of what Taylor aimed at and achieved, and how his life-work swelled into a mode of thought, which we believe is destined to redirect the whole trend of industrial progress. If the words spoken by a certain gentleman are true of the man—"What Mr. Taylor did was to go out into the works and start a revolution"—they are true also of what Mr. Taylor's philosophy will yet achieve in the whole fabric of industry.

To those who, like myself, have studied scientific management from afar, who have not had the opportunity of coming into touch with its pioneers, who have not experienced the rough-and-tumble of its youthful encounters, this book comes as an illuminating story. It has rendered the whole thought of scientific management far more intimate and personal. It has clothed it with human form, and brought all the kaleidescopic thought, activity and experiments back to the thought of a man strolling across the sloping lawns, beside the herbaceous borders, under the rose arches and between the box hedges of a garden. This philosophy which I have studied and endeavoured to apply is not now something abstract and theoretical; it is very human. It is a delightfully living medley of time studies and weird golf clubs, of planning rooms and forceful epithets, of minute experiments and amateur theatricals, of tool rooms and of "my little intellectual friend," Putmut the cat. I am glad to think that the chief exponent of scientific management was a brilliant tennis-player, a fine gymnast, captain of his Exeter baseball team, and, later on in life, a most stimulating father to two lads. It puts a complexion on scientific management which makes me believe in it all the more. It is no longer something imposed on the world out of an ethereal void, but something that has welled up from the work of a man who made his daily trip to the factory and, at night, read aloud "The Lure of the Labrador Wild" to his family . . . .

Indeed, Frederick Taylor seems to have been more normally human in many ways than most men who have left their imprint in history. No man of whom it can be said—and by a lady too—that he "never seemed more of a gentleman than when he was swearing," and who can come out with such sweeping statements as "All Germans are liars," and "You can't introduce economical methods by sitting up and howling," can but be held as a human among humans. He found public speaking a stumbling block; he wrote with difficulty; mental agility was not his strong point; his swearing, when necessary, was forcible—all features of the people one meets in the day's march. His home life was wholly delightful. His relations with his adopted children—now stern, now mischievous, now tender—tell us of a man to whom fame brought no pride. "He was kept humble by his knowledge of the ability he did not have and the things he did not know. There was much that was wistful in his attitude towards men who spoke familiarly of things upon which he felt he had no light." Despite the strain of his work, despite the opposition he encountered, and despite the increasing reputation which brought him scores of visitors and shoals of correspondence, this man, of whom things both laudatory and damnatory were spoken with unusual vigour, retained a character singularly free from the faults which are associated with fame. Nothing from this outside world could break the serenity of his home. No reports or rumours could disturb the openness of his hospitality, the sociability of his nature, or his loyalty to and thoughtfulness for his friends. It is not to be wondered at, therefore, that those who visited him should, having come to see the leader of a new movement, have left, admiring not only an able thinker but a manly character. Thus, Mr. Brandeis wrote:

> I quickly recognized that in Mr. Taylor I had met a really great man—great not only in mental capacity, but in character, and that his accomplishments were due to this fortunate combination of ability and character.

And Rudolph Blankenburg expresses the same dual charm of the man in the eloquent words he delivered at the Taylor Memorial Meeting:

> Mr. Taylor was to me a paradox. On one hand we find his rugged intellect blasting its way through layer after layer of conventions formed by generations of prejudice, tradition and ignorance until he became recognized as perhaps the world's foremost industrial leader. When truth was at stake, he was resourceful, robust and tireless. The problem once even dimly visioned he pursued with the zest of a hunter until he conquered. On the other hand, those whose contacts with him were, like my own, only casual and who went to him as converts, rather than to be converted, could hardly sense his power. He was born and bred to a gentle manner. His sweet smile and courtly bearing were only the surface indications of an innate and broad spreading sympathy and kindliness. He knew he had much to give and he gave it with a generosity which knew no limits.

Mr. Copley has been both faithful and wise in including in this book so much of Mr. Taylor's personal life, as distinct from his work. Character, indeed, plays a leading part in the achievements of a man; how much, I fancy, we sometimes underestimate. Brandeis glimpsed how much the character of Taylor had contributed to Taylor's life-work. Perhaps others in his day would have viewed scientific management in a different light had they known the character of the man behind it. How alien to Taylor's character was much that they attribute to scientific management! How contrary to Taylor's ethics were some of the motives attributed to the man whom they knew only through the second-hand channels of books, newspapers, rumours and the experiences of others! A downright man, true; an outspoken, often brusque man, true; a strict, exacting, imperious man at times, true; a man, who, having suffered, was perhaps a little intolerant, perhaps a little stinging, true; an impatient, tactless man, maybe. "But, however much he might irritate men, they had a habit of saying: 'Well, you know where you stand with the doggone cuss, anyway' "—and that sentiment is not a tribute either to a great thinker or a great scientist and inventor, but to a commanding character,—a character which flamed with enthusiasm and courage, and bore honesty and a meticulous regard and respect for justice emblazoned on its shield. It was open to men to question Taylor's abilities, if they could find a cranny wherein to fire a shaft, but none could gainsay either the qualities and motives he brought to his work, or the charm and friendliness he displayed open-handedly in his home. Here, indeed, was a man, a chip of common manhood, a whole-hearted liver of life.

Like all men who have set in motion or furthered great mental revolutions in the world, however, Taylor brought to his work, not only a high character but also a truly remarkable mental ability. Primarily, his mind had in the highest degree those qualities which we associate with the scientist—critical, inquisitive, thorough, painstaking, logical, tenacious, persistent, constructive. He had preeminently the scientist's passion for truth, the scientist's reliance only on those facts which, by endless experiment and testing, are proved to be true.

> His reputation (said Henry L. Gantt) does not depend upon the fact that he designed and built the most successful big steam hammer in the world, or that he developed a method of treating tool steel that trebled its cutting power, or that he determined the laws of cutting metals, or even that he was the father of scientific management. These were incidents in his career, and only the logical results of his methods. At an early date, he realized how much of the world's work was based on precedent or opinion, and undertook to base all his actions on knowledge and fact.

In other words, his chief claim to fame, as indeed it was the chief attribute of his mind, was his use of the scientific method and his elaboration of a science for everyday practical things. He was not only a supremely scientific man, but he was bold enough to apply his scientific mind to things for which it was little thought a science could or should exist. As Mr. Copley points out, he thus anticipated a subsequent prophecy made by Mr. H. G. Wells, when he wrote, in one of those delightfully interpolated reflections with which he is wont to add to the fascination of his novels:

> When the intellectual history of this time comes to be written, nothing, I think, will stand out more strikingly than the empty gulf in quality between the superb and richly fruitful scientific investigations that are going on, and the general thought of other educated sections of the community. I do not mean that scientific men are, as a whole, a class of supermen, dealing with and thinking about everything in a way altogether better than the common run of humanity, but in their field they think and work with an intensity, an integrity, a breadth, boldness, patience, thoroughness and faithfulness—excepting only a few artists—which puts their works out of all comparison with any other human activity . . . . In these particular directions the human mind has achieved a new and higher quality of attitude and gesture, a veracity, a self-detachment, and self-abnegating vigor of criticism that tend to spread out and must ultimately spread out to every other human affair.

Taylor himself realized something of the novelty of his work in this sense, when, in 1912, he said: "A very serious objection has been made to the use of the word science in this connection (that of management). I am much amused to find that this objection comes chiefly from the professors of this country. They resent the use of the word science for anything so trivial as the ordinary, everyday affairs of life."

Taylor, indeed, must rank among the greatest of scientists for, not only did he prove himself an incomparable exponent of the scientific method, but he built, on the basis of his research, a new science, and a science in a new field, far from the laboratories of the universities, where the clangour and smoke of factories strike the air, and men dig and shovel and carry and draw. He made everyday things the subject of thought, and thereby raised them. He lifted the toilsome task of the labourer out of the ruck and muck and "lit it up with a ray from the realm of pure intellect." High tribute, indeed, was it to receive from such a man as Le Chatelier, professor of chemistry in the Sorbonne, the words, "I was somewhat ashamed to find the science of a practical man infinitely more developed than my own . ."

It is strange to think that this man, who began his work in industry on the floor of the Midvale machine shop, who moved from clerk of the shop to work as a machinist, who then became gang boss in charge of the lathes and subsequently became foreman, chief draughtsman and chief engineer successively—this man, who, in his early days, worked from 6:30 to 5:10, who often volunteered to work on Sundays as well as overtime on week days, whose drawings William Sellers flung in the fire, who stopped the daily beer and whiskey wagon driving into the Midvale works—this man, who fought his way from the lowest and lived his life among the hard knocks and rough-and-tumble of the factory, should have, in such surroundings and as a part of such a life, brought to bear on his work a mind so scientific that it has come to command the respect of the whole world of science.

What Taylor achieved, however, could not have been won by a scientific mind alone. There were other mental qualities which contributed to this success. Of these, I should place foremost his determination, persistency, thoroughness, tenacity, and above all, enthusiasm. These are qualities, of course, common to most successful men who have encountered opposition in the pursuit of their ideals. Yet, recurring again, as they do, in the life of Taylor, one cannot but marvel as, at every turn in his life, they loom into prominence. One can quote from this book instance after instance where Taylor, had he been of poorer clay, would have taken the easier road. It may seem a barren field of battle in which to try such highly tempered weapons as Taylor's persistency and thoroughness—this machine shop at Midvale, for example. Yet the story of Taylor's struggle with his men, ending, as it did, in a most solid hold upon them, reads like the yarn of an Arctic explorer. Only infinite determination, inexhaustible enthusiasm and unyielding persistency could have climbed the obstacles which were laid in his path. It was the same throughout his life. Nothing was impossible, if it were necessary. Few men would have won the degree of M.E. when occupied, in the whole-hearted way he was, in the work-a-day toil of the shops. Few men—to take a more domestic incident—would have planned the removal of old box hedges with the thoroughness and disregard for precedent and prejudice with which he undertook it. "We were told," wrote Taylor, "not only by the former owner of the place, but by all the gardeners and landscape architects whom we consulted, that it was an impossibility." Yet, he set to work in his own scientific way to solve this 'impossibility,' as he had solved many another greater one; and later, one might have seen box hedgerows in huge wooden crates, pulled by horses, running along a wooden track, to their new destination. Where others had failed, Taylor succeeded. It was characteristic of Taylor's whole attitude to things that wanted doing,—whether it was to increase the cutting speed of steel, to ensure the proper care of belting, to learn the content of the shoveler's task, or to elaborate functional foremanship in the Bethlehem machine shops. In big things and small things, there was always the same undaunted persistency and thoroughness, kept going by an enthusiasm, which not only made him a supreme optimist, but drew others along with him. "Why, he would have filled up a corpse with enthusiasm, if only the corpse could hear," said a Midvale executive. His whole work, viewed from this angle, was, indeed, little short of amazing. For years, industry had revolved in the same old way; then, the youth Taylor enters Midvale, and within ten years, not by any great display of mental genius or brilliant discovery, but by sheer drive and tenacity and enthusiasm, coupled with an unfailing belief in and use of the scientific method, this man, between the ages of 22 and 32, set the whole establishment buzzing along lines which had hitherto hardly been imagined. As an example of mental intensity, I know few achievements, whatever the field, to equal it.

In reviewing the mental attributes of Frederick Taylor, moreover, one cannot but refer to those other qualities which formed, as it were, the complement to those we have already noticed. I mean his intensely logical mind, his genius for detail, and his boldness in construction. These were the qualities which enabled him to found his constructive work on fully analyzed bases of fact. In speaking of Taylor's work at Midvale, Carl Barth says:

> He constantly investigated tools and other small appliances that gave minor trouble or fell short of giving entire satisfaction, and in discovering the cause of their shortcomings, was able to effect highly-desirable improvements. Many of these improvements probably could easily have been made by anyone else who had taken the trouble Taylor did to investigate. The basis of it lay in the fact that it was Taylor's genius to recognize the importance of trifles.

To Taylor, nothing was too small or insignificant. It was the little motions, the little adjustments, the little elements which were the basis of his whole philosophy. He realized to the full that, for the average man, invention itself was a question of studying the detail.

> It is thoroughly illegitimate, he said, for the *average* man to start out to make a radically new machine, or method or process, new from the bottom up, or to do things most of which have not already been done in the past. Legitimate invention should be always preceded by a complete study of the field to see what other people have already done.

What Taylor meant by a "complete study" may have differed from what his hearers interpreted it to mean, but to him it meant a study so exhaustive that every detail was laid bare before his microscopic eye. Perhaps what Mr. Copley has entitled "A Tale of Shoveling" is the supreme example of this Taylor genius for detail, though the work which led up to his discovery of high-speed steel is an equally striking illustration.

> Now, gentlemen (said Taylor in giving evidence before the Special Committee of the House of Representatives in 1911-12) shoveling is a great science compared with pig-iron handling . . . . Under the old system you would call in a first rate shoveler and say, "See here, Pat, how much ought you to take on at one shovel load?" And if a couple of fellows agreed, you would say that's about the right load and let it go at that. But under scientific management absolutely every element in the work of every man in your establishment, sooner or later, becomes the subject of exact, precise, scientific investigation and knowledge to replace the old "I believe so" and "I guess so." Every motion, every small fact becomes the subject of careful, scientific investigation.

Taylor was speaking out of his experience. In describing the method of scientific management, he was emphasizing that application to detail which was one of the distinguishing features of his own genius.

As is often the way, this capacity for detail was part and parcel of a highly logical mind. The successive steps which Taylor took in the expansion of his system form a singular picture of lucid, constructive thinking. It is an entire misconception to believe that scientific management originated as a theory and that certain mechanisms were subsequently devised for the application of the theory. The story is wholly the reverse. By the singular efforts of a shop foreman to solve his practical shop problems, certain mechanisms were designed and applied, which one by one led on to other mechanisms, each one requiring a further one, till what had grown as need arose became recognized as a system. The system being recognized, there came the final stage of deducing from the specific mechanisms those principles which seemed to be of general application; and thus in the end came a philosophy. It was the logical thinking of Taylor which made the various mechanisms fit into a system. The detailed investigation of machine operations and handling times came first; from this, it was possible to deduce standard methods of operation. Standard methods of operation required, for their continuous performance, standard conditions of working. There were devised, consequently, such mechanisms of management as the tool room. But this divided the worker from his implements and materials. A condition of obtaining standard output was the delivery of "the right materials and the right tools in the right condition to the right man at the right machine with the right instructions at the right time." This inevitably led to the development of planning. But how to get the worker to operate correctly? The only way was to supply detailed written instructions; and, in order to have those instructions scrupulously observed, to devise a wage-system which would provide extra wages for following the instructions. Thus, in a series of consequential stages, Taylor came to his functional organization,—looking back, a remarkable feat of logical thinking. As Dr. Person said, when under his direction the Amos Tuck School made scientific management the basis of its instruction in management—"We found that the Taylor System was the only system of management which was coherent and logical, and therefore was teachable."

Of the further quality of inventiveness which Taylor possessed, there is little need to speak. His inventiveness was implicit in his spirit of scientific enquiry. His inventions were not born of revolutionary genius, but of the naked truths which his minute investigations brought to light. His famous steam hammer,—of which Gantt said, "I do not know of any more daring piece of engineering construction"—was not the outcome of what Mr. Copley calls "an egotistic desire to be original, to do great and glorious things," but rather was it the logical consequence of a long and painstaking survey of other steam hammers and of what a steam hammer ought to be and do. But I do not dwell on this, for Taylor's inventive work was due to attributes which we have already discussed.

That there were flaws in Taylor's mental equipment will be readily understood. His abilities were outstandingly those of what we have come to call the "engineering" type of mind—the mind which, "works for the solution of a single technical or engineering problem and is concerned with the determination of the solution rather than the application of that solution to practical activities." As an executive, it cannot be doubted that, despite a high order of ability in management, he had serious defects,—the defects of a man who has thought far ahead of the practice, and is impatient that the practice should catch up; the defects of a man who has probed to the very truth of things and is careless of aught but the truth; the defects of a man who followed where logic led him, and was scornful of the roundabout way of reaching a conclusion. I think, too, we must class among his defects his antipathy (if the word is not too strong) to the "academic" and the "humanities." It is a common fault of practical men, though most successful practical men, unknowingly perhaps, are already possessed of those qualities which real culture furnishes. "Real culture," says Mr. Copley, "is that which widens one's sympathies and thus is the cure for egotism or the inability to see oneself and one's work in proper relation to the universe." That is as good a definition as I have heard, and it is true to say that, in many respects, Taylor stood in need of no such cure. But, here and there in his life, one can see how this refinement of culture was lacking. He had great difficulty in formulating the philosophy of his achievements. None of his published works completely portray the essence of his philosophy. There was just lacking that breadth of perspective as a permanent attribute of the man. In flashes it came; within himself, inchoate and uncrystallized, it was there; but it was not a lasting light which he could turn on at will to reveal the inwardness of his life work. That others, who have taken upon themselves leading parts in the subsequent work of scientific management, have been university men, replete with the qualities which that training provides, is evidence that a movement so broad and so revolutionary has need of and can find niches for every type of mind.

To dwell upon the flaws in a mental armoury so commanding as that of Taylor is, however, to pick holes in the sky. I have left little enough space to consider what great thing it is that Taylor has contributed to the progress of the world, and to what particular end he himself considered his work had contributed.

Too little emphasis has, in general, been laid—an omission which this Life amply rectifies—upon the motive which caused Taylor to start upon and continued to inspire him in the work he achieved. Again and again, throughout his life, in terms which are absolutely unmistakable, Taylor testified to the one main purpose which dominated his work. In 1912, when referring to his first steps in developing his system, he said: "My whole object was to remove the cause of antagonism between the boss and the men who worked under him; to try to make both sides friends in the place of tactical enemies." The same thought is uppermost when, in 1914, in reply to certain criticisms, he wrote: "I cannot agree with you that there is a conflict in the interests of capital and labor. I firmly believe that their interests are strictly mutual, and that it is practicable to settle by careful scientific investigation the proper award that labor should receive for the work which it renders."

It is usual to speak of scientific management as a powerful lever in the elimination of waste, as the means best calculated to arrive at effective management, and as a sound set of principles to govern the development of an organization. But that was not the primary point of view which Taylor took, though the "engineer" within him could not but be gratified by such results. To Taylor, his system of management was primarily a means to eliminate the cause of friction between management and men. He held the old type of management responsible for the chaotic condition of industry in its "humanics." He drove to the heart of it, and determined not merely to effect a cure, but to remove the cause. We should regard scientific management, therefore, as preeminently a plan to solve the great social problem of industry, and secure an enduring industrial peace. It is for that reason, prime amongst others, that I regard the philosophy of scientific management (and, indeed, many of the mechanisms which Taylor introduced to put his philosophy into practice) as among the greatest of modern contributions to the progress of our social economy. It is not simply and solely a means to greater output and efficiency; still less is it a means to greater profits for the individual business. Primarily, its object is to remove the cause of strife and promote peace. Its field of service is not limited to this or that business; it is not even bounded by the confines of industry. Its service is to the world.

It is strange that, with this motive and object inspiring the work of its founder, scientific management should have been so strenuously attacked for its effect upon the worker. It has been accused of making men into machines, of creating narrow specialists in place of all-round operatives, of creating and furthering the monotony and consequent fatigue of the workers' life, of reducing the chances of a "square deal," of dispensing with the need for skilled workers, of overworking men and causing physical ills, of destroying initiative, inventiveness and ingenuity, of aiming to do away with unions, and of robbing the worker of his legitimate earnings. By far the most formidable attacks upon scientific management have been from this angle. Yet Taylor himself said, "It appears to me that the effect of the system upon the workman is in the end the most important element in the whole problem," upon which Mr. Copley comments, "He regarded the reduction of labor costs as *very* important, and he regarded the increasing of wages as *very* important. But it was his deliberate opinion that the *most* important feature of any system must be its effect upon the workman's character." Of this fundamental purpose in Taylor's work his opponents, and perhaps some of his supporters and followers, have been neglectful. If for no other reason, the writing of this book would be well worth while, for its reminder to us that the main object of scientific management, in the conception of its greatest protagonist and exponent, was to better the human side, the "humanics" of industry.

There is, even amongst the most progressive employers, a tendency to think that the solution of the great human troubles of industry is not a matter for scientific research or for scientific administration. They fancy that it is a question of the heart rather than of the brain, thereby omitting to realize that the one is essential to the interpretation of the other. They often quite properly set up employment or personnel departments, but fail to realize that, though one may segregate in special units of the organization certain specific activities affecting the workers, one cannot by any means, divorce the broad problems of industrial relations from the day-to-day management. For management is essentially a daily relationship with the workers; these relations constitute the main problem of management. Any remedy must resolve itself into an improvement of the management. Any study of the causes of the problem must be a study of the methods of management. This is, indeed, fundamental to Taylor's philosophy. He would claim that the contribution of industry to social welfare is to be judged, not merely by the presence or absence of employment and welfare work, but by the extent to which *all* the work of management is motivated by and conduces to sound industrial relations. He would, I surmise, strongly deprecate the conception, which arises even in the best regulated industries, that managerial efficiency is something alien from the proper care of labor and from the study and practice of means to achieve a lasting settlement of industrial strife. On the contrary, he would claim that these things are possible only through scientific management, and that, in the individual factory, the burden of attaining these objects rests mainly on the shoulders of those who organize and manage the production and distribution of goods, and only in a certain specialized degree on those who specifically are charged with the care of the workers' welfare. The labour problem, in fact, is not an isolated problem, to be dealt with by units not directly responsible for production and distribution, to be studied by organizations divorced from the daily planning and execution of work, but rather one aspect, and the main aspect, of the whole work of managing a business scientifically. The conception that responsibility for promoting sound industrial relations can be allocated to one specific unit, that such work calls for specialized capacities and is aimed at objects of only secondary importance to other units in the organization, is wholly opposed to Taylor principles. The object of scientific management and organization *is* the betterment of labor conditions and the promotion of peace; the whole organization is indeed a personnel department. The development of sound labor policy is, in fact, synonymous with sound organizing and management.

It is on this ground that scientific management, as a great movement, may rightly claim to be serving, not just this or that particular business, but the whole world of industry and the social and economic life of the community. It is not just a means to greater efficiency, in the sense of producing more goods, but a profound contribution to bettering the life of the community.

> I have been devoting my whole time (said Taylor) and almost every cent of money which I can spare from my income, to promoting the cause of scientific management; and my object in this work is primarily, I may say almost entirely, that of securing a larger measure of prosperity and happiness for the working people. I am, of course, and ought to be, interested in the material welfare of the companies who are using scientific management; but if the results of my work were merely to increase the dividends and prosperity of the manufacturing companies, I certainly should not devote my time to this object. Scientific management is for me, then, primarily a means of bettering the condition of the working people.

Listen again to the significant words which Dean Sabine, of Harvard's Graduate School of Applied Science, addressed to Taylor:

> While listening to you and even more in thinking it over since I left you, I am persuaded that you are on the track of the only reasonable solution of a great sociological problem. The systematization and standardization of work has a bearing far beyond the organization of a particular business or industry. I do not believe that you are a socialist any more than I am, but you are preparing data for the solution of a problem on which socialistic and cooperative movements have time after time been wrecked.

Far too little has been heard and far too little account taken of the possible contribution of management, scientifically conducted, to what one may call the sociological problem of industry. Some of the greatest minds have striven with the problem of capital and labor, as if these alone constituted the body of industry. Modern sociological and economic thought has yet to realize that management is a third partner, whose position renders it an authoritative partner; that neither panaceas nor changes in heart, neither socialistic programmes nor experiments in cooperative working and governance will singly bring about a redirection of social progress, but rather the application to industry of the analytical and synthetical methods of science, by a body of management inspired by right-minded motives and viewing its work, in the day-to-day control of its shops and factories and warehouses, as highly constructive work in the building of a new order and the development of a new spirit in industry.

Consideration of Taylor's motive automatically tells us what was his conception of scientific management. To him, it was a philosophy, not a set of mechanisms or a hide-bound system. "The essence of modern scientific management," he said, "consists in the application of certain broad, general principles, and the particular way in which these principles are applied is a matter of entirely subordinate detail." And again, he said, "In its essence, scientific management involves a complete mental revolution"—on the part of the men and of the management. To this broad vision of scientific management he held throughout. In later years, when efficiency became a craze, and efficiency societies sprang up like mushrooms in a night, he maintained his same attitude—that scientific management was not essentially any of these things, but was "something that varied as it was adapted to particular cases, *but always involved a mental revolution of employer and employee toward their work and toward each other.*" To Taylor, scientific management was a journey to an ideal, a course which led to some ultimate condition. It was not a static system, but a dynamic philosophy. "Scientific management," he said, "fundamentally consists of . . . . a certain philosophy which can be applied in many ways," and philosophy is purposeless without an ideal, and fruitless save as it serves to move life forward towards that ideal. One of our dangers is to regard scientific management as something we have "installed," when the essential consideration is whether our management and our men have achieved that mental revolution which makes any set of mechanisms living and permanent. In a phrase, this "complete mental revolution" consists of "recognizing as essential the substitution of exact scientific investigation and knowledge for the old individual judgment or opinion in all matters relating to the work done in the establishment." The Taylor ideal was a condition of industry where its daily tasks had been subjected to the reign of law, scientifically established, and equally binding on management and men. Towards this ideal his work was one long, consistent struggle. What was, indeed, the core of his work at Bethlehem? "Essentially, it was this: that the government of the Bethlehem Company cease to be capricious, arbitrary, despotic; that every man in the establishment, high and low, submit himself to law." "The gist of the matter is," wrote Taylor, "that scientific management demands that the acts of the men and movements of all these men and elements shall be regulated according to clearly defined scientific rules and formulae."

The most significant feature in Taylor's efforts to reach this ideal, however, is the fact that his main difficulty lay with the management rather than the men. Despite his early tussle with the men of Midvale, the main combats of his life were with those in the management. In some instances he encountered direct opposition; in others he had to face the perhaps even more difficult problem of the man who enthused over scientific management for others, but was himself not in need of its medicine. "It took over two years," said James M. Dodge, "for our organization to surrender fully, and so change our mental attitude that we became really receptive. I mean by this that I found no difficulty at all in having the heads of various departments agree that the introduction of the Taylor system would be most desirable, but in each case it was for everybody else in the establishment but entirely unnecessary for him." Taylor's own difficulties at Bethlehem and those of his associates in other plants afford ample evidence of the toilsome task it was to bring about in the various managements that "mental revolution" which he himself postulated as the essence of scientific management. Yet it was only to be expected, and remains still one of the major problems of his followers. For, upon management Taylor threw a greater burden; he made operative efficiency a problem which was up to the management. Moreover he demanded that management should subject itself to the reign of law which was the outcome of his scientific investigations, and further demanded that the petty despotisms of the old-time foremen and managers should be broken down, their work scientifically organized, and their positions rendered rather that of teachers than of driving masters. It was only human, perhaps, that these innovations should be opposed, and the "mental revolution" a very slow grinding of the wheels. Conservatism and inertia are the property of no class, and Taylor had too many sad experiences with managers to escape this fact. "It was his mature judgment," says Mr. Copley, "that the philosophy of 'initiative and incentive' was, in the main, the lazy manager's philosophy; the management could talk as it pleased about the workmen being supposed to be expert in their trade, but the real reason for putting the details up to the workmen was likely to be that the management was disinclined to assume the duties, burdens and responsibilities that naturally belonged to it."

Yet, it was true in Taylor's own work and is true today that efficiency must begin at the top. The workers cannot transfer their skill to a management which is not ready to receive and use it, nor can they single-handed standardize the conditions of their work. The development of efficiency is primarily a task of management, and efficiency is primarily a question of efficiency in those who direct and control the work of others. "Scientific labor can exist only as scientific management creates it. There is no labor that is scientific that is not the product of long arduous study with the methods of the laboratory," said Mr. Ernest H. Abbott in a singularly discerning statement. Management has yet to measure itself up to the standard which this ideal presents. It has yet to appreciate its responsibilities and the vast intricacy of its task. Whilst it continues to fall short, waste is the difference between what management is and what it should be. Of all documents perhaps the report of the Committee on Elimination of Waste in Industry is the strongest condemnation of the old-time management. It publicly places the main responsibility for waste on management. It is both a condemnation and a challenge. The philosophy of Taylor alone points the way to greater efficiency and it is upon management that the main responsibility must lie for bringing it about. General Crozier singled out as the feature which distinguished the scientific from other principles of management "the amount of administrative energy which is devoted to it," and by that energy alone is the herculean task of attaining the highest efficiency to be completed. Even amongst the managements which are definitely in sympathy with the underlying principles of scientific management, there is often a certain hesitation in putting any system based on those principles into operation, on the score of expense. Taylor himself, in fact, was often accused of "making the money fly." The tendency of most manufacturers, especially in times of depression, is to keep a very tight grip on the expenses ledger. Any system of scientific management, however, by throwing a greater burden on the management and by insisting that management shall work scientifically and not by arbitrary "rule-of-thumb" methods, necessarily involves, in most cases, an increase in the number of purely brain-workers over the number required under any non-scientific system. "The belief is almost universal among manufacturers," writes Taylor, in "Shop management," "that for economy the number of brain-workers, or non-producers, as they are called, should be as small as possible in proportion to the number of producers, i.e., those who actually work with their hands." And again, he wrote, "It has been my observation that there is no definite relation of any kind in the ratio of overhead expenses to direct expenses in the prosperity of a company . . . . I have found, however, that those companies which are managed in the very best way and which are earning the largesst dividends in relation to their competitors, have the largest ratio of overhead expense in relation to direct expense . . . . As a general rule, I can say that the more men you can have working efficiently in the management, that is, on the management side, the greater will be your economy. No greater mistake can be made than to assume that economy is realized by cutting down the so-called overhead expense. Just the opposite is true in the very best managed companies." Mr. Copley's comment on this extract—that Taylor was a voice crying in the wilderness—is apt indeed, and is still largely true.

Management as a corporate body in industry has yet to see itself in its right perspective. It has yet to appreciate that business is progressing beyond the stage where it was a game of chance, a selfish, crazy tussle with capricious fortune, with alternating profits and losses, and is gathering speed towards an order of industry where the motive is that of social service and the methods are capable of scientific determination and regularized control. Progress towards this ideal is overwhelmingly dependent upon the energy, concentration and genius of management. Management will be called upon for a far higher standard of ability, a far higher concept of its duties and its relationships with the workers and the community, and a far higher development of its technique. It must bring more brainwork to bear on its task, more ethical considerations to fashion its motives and objectives. Perhaps the essence of what this deepening and widening of the sphere of management involves may be put in a phrase —that management is tending and must further tend to become a profession. The practise of a profession presupposes several things: firstly, a codified and proven body of knowledge, or, a science; secondly, a skill in the application of that knowledge, or, an art; thirdly, a progressive enlargement and intensification of the knowledge, or in fact the constant use of the scientific method; fourthly, a standard by which efficiency in the practise of the profession may be assessed; fifthly, a motive which places first the good of the community. If then, these be the conditions of a profession, management, as Taylor conceived it, and as the industrial world is now slowly coming to conceive it, is indeed a profession in embryo. It is the task of management—as skill comes to replace chance and luck, as more and more thought and research expands knowledge, as definite criteria of efficiency become possible for its various branches, and as the element of social service drives out the false domination of petty autocracy—to develop itself into a profession, with professional standards and ethics.

To this end all Taylor's philosophy leads us; towards this ideal, the idealist in him constantly strove. "It is the promotion of harmony between employers and their workmen that is my chief interest," he said. And again; "All our inventions are meant to contribute to human happiness." Above all men, perhaps, Taylor exemplified the new management to which his vision and work gave birth—a management directed by a social motive, yet operating by severely practical and scientific means.

This book tells us of Taylor's own life and work, but in the few years since he died, the outcome of his work has been a universal stirring of management to an appreciation of its responsibilities. Consciously or unconsciously, this new movement has been inspired by his teaching and leadership. Scientific management has come to be recognized as a philosophy which is applicable, not only to shop management, but also to every activity of a business, from accountancy to selling, and, further, to every corporate enterprise, whether it be a manufacturing concern, a professional society, or a municipal organization. His principles have spread, like a great flame over all the world. His published works have been translated into every language, from English to Chinese, from Russian to Spanish. Both the French and Soviet Russian governments have given his principles official recognition. From Vienna to Paris, Paris to London, and London to New York, the work he began is being carried on by his followers.

Bringing into the very shops of industry the quality of thought which is normally the attribute of the hermit of the laboratory and study; working in happy cooperation with other pioneers—his friends one and all, whose devotion to him was only equalled by his friendship and respect for them;—gilding his work with the rare gleams of far-looking visions, and buoying it ever on the tide of a high motive and objective; delving deep into the caverns of truth in the work-a-day things of life, and pressing fearlessly forward where the light of truth led him—Frederick Taylor set on its path a movement which, when the time comes to see it in its proper perspective, will have been found to have given a redirection to our social progress. At a time when industry was reaping the shrivelled harvest of low ideals and selfish, unenlightened management he brought to it the fertile seed of high ideals and unselfish, enlightened management. "He injected the concept," in the words of Dr. Person, "that a business should exist for social service, that its purposes can be defined, its objectives planned and scheduled, detailed execution be so controlled as to contribute most economically to the final result, and that the final result can be a productivity of useful things so shared as to increase the comfort and promote the happiness of all concerned." Wherever scientific management is the philosophy governing the conduct of any enterprise, there will Frederick Taylor's spirit—and, as he would wish it, the spirit of his associates—be found still working. The day, indeed, cannot be far distant when scientific management will come to be recognized as a great social movement, not only by those in industry who are the immediate objects of its service, but by all that commonwealth which industry itself serves.

It was time that the life of Frederick Taylor should be written and published to the world, for, if he was a generation ahead of his time, that generation is now with us. He blazed the trail; we put foot upon a more royal highway. No more inspiriting message could come to us than this story—so faithfully told, so intimate yet so heroic and portentous—of the life of him who has been named, in a significantly mingled title,—a mingling of the man and the mission, the family and the world, the sowing and the fruit, the present and the henceforward, the mortal frame and the imperishable legacy, the body that fails and the thought that prevails—"The Father of Scientific Management."

IT IS a great undertaking to present a significant and many sided life and at the same time to describe, in two volumes, the developments of an industrial movement involving many lives. Mr. Copley has succeeded admirably in this difficult task. He has chosen what would probably have been the only satisfactory method, because throughout his entire life Taylor's overmastering interest lay in his work and its development. Mr. Copley has been singularly successful in his description of Taylor's personality, and here again he has a difficult task, because of the wide variety of his readers . . . .

The book is to be commended to every one interested in the history and development of scientific management, and to everyone who values a noteworthy biography. Only those who knew Taylor and studied and marvelled at the magnitude of his achievements and his continuity of purpose can appreciate the portrait that Mr. Copley has painted, but every reader must feel that there is a fine presentation of a great man. (Lillian M. Gilbreth in *American Management Review,* March, 1924.)

Making the Most of Men[1]

By Ida M. Tarbell[2]

658.
658.92

NO MAN in the history of American industry has made a larger contribution to genuine cooperation and juster human relations than did Frederick Winslow Taylor by his "Principles of Scientific Management." He is one of the few—very few—creative geniuses of our times.

The importance of the principles which Taylor developed has been amply demonstrated, but their potentiality has been hardly touched. It is the future that will prove what they can do for humanity. A few wise men have seen this from the start. Lenine saw it. The best of the American, English and French industrialists have seen it, but the world at large barely knows his name or knowing it execrates it as that of one who has taught how men might be more effectually exploited.

It is most fortunate that the first life of Taylor should have been done by one who understands the meaning to humanity of his work as well as one who appreciates to the full his unusually pungent personality, also by one who was not afraid of the hard work of mastering great masses of difficult technical material thoroughly enough to interpret them to the general reader. Frank Barkley Copley, the author of this life, has given himself to the task as fully as a man could and as gladly, for he reverenced Taylor and his aims and asked nothing better than to help others to understand him.

Taylor, born and bred in gentle surroundings, was cut off from college by defective eyesight. He turned by natural instinct to industry—his aim engineering. He began at the bottom in a shop, and immediately this youngster of unspoiled intelligence and of entire integrity of character found that he was set down in a world where management was hit-and-miss and where operations were conducted by rule-of-thumb. He found himself held back by the superstitions, taboos, suspicions, ignorance of employer and employee. The industrial world of the 70's was one of fallacies. On the side of the employer was a superstitious fear of overproduction and a belief that "the lower the wages the higher the profit." On the side of the employed was a corollary fear that there was only so much work to be done and therefore you must do only so much in a day and never as much as you could. Machines must be held in. To young Taylor all of this was wrong in aim, cruel in effects and false in principle.

In the first interview I ever had with Frederick Taylor he began by telling me how early he had been impressed with the idea that the mission of industry was to produce abundantly in order that all men might enjoy abundantly. To limit your own production or others' production, not to give the fullest opportunity and the fullest return to each for what each did, impressed him as defrauding humanity and curbing human capacity, and yet that seemed to be the practice of both labor and capital.

He was a blunt man, and from the beginning of his shop associations fought his fellow workmen, his foremen, his employer on these points. Not only did he struggle to get out of a machine all of which it was capable but he fought to improve both machines and processes. Invention after invention poured from his fertile hand and brain—a steam hammer, of which so great an engineer as Gantt has said, "I do not know a more daring piece of engineering construction." Then the art of metal cutting—a better steel for tool—revolutionary developments. There were improvements in belting, in oil machines. Nothing that he had to do with satisfied him, so deep was his feeling that man's business in the world is to improve all he touches.

One of Mr. Copley's achievements in this book is making the reader feel the struggle of mind, the struggle in human relations that it cost Taylor to effect each one of these changes. He had men against him—the men he worked with, the men over him. He was a nuisance—a dreamer—a disturber of the things that are; and every form of opposition, including continuous ridicule, followed his efforts. But he could not be stopped or downed—the creative power was too intense in him. He had too great a reverence for it to allow stupidity and narrowness to chill or hinder it.

These inventions and improvements of his show the mettle of the man; but there was something broader than mechanical genius and an unbreakable will to keep it active. There was a most interesting and beautiful sense of human beings alive in Taylor. He saw their capacities atrophied by the industrial fallacies of the times and from the start he sought to free them. A man should have pride in his own capacity. He should have an incentive to make the most of himself. In every shop he entered he endangered his position by his unwillingness that the earning capacity of any man should in any way be hindered. He wanted a man to make all that he rightfully could and he wanted to help him in that by making the conditions under which he labored stimulating rather than hindering. That meant that a man must work in an orderly, systematized shop, have helpers when necessary, be trained for his task, be in constant friendly relations with the management, his suggestions listened to, instruction given him if needed.

---

[1] Reprinted by permission from *The Saturday Review of Literature*, October 25, 1924. The caption is ours.

[2] Investigator and Author, New York City.

It was out of this effort to make the most of men that his principles of management grew—the greatest contribution that we have had, in our time certainly, to the future of labor, for these principles free the employee from rule-of-thumb, bring science to the aid of his task—boldly announcing that there is no task so humble that it is not worthy of scientific study, that the study cannot be done by superiors and imposed upon the worker but that it must be done in cooperation with the worker, and that his ideas must be heeded and studied. His system would take unskilled labor out of the world, would give a formula for every task and furnish training to the man who undertook that task.

It was by years of study and experiment, made under constant hindrance and ridicule, that Taylor developed these principles. Copley shows us vividly how the man's vision, integrity, fighting spirit slowly and surely demonstrated them. It is a great story of a human fight and victory.

A Hero of Industrial Progress[1]

By Allan Nevins[2]

658.
658.92

SUPPOSE an educated Frenchman, German, or Scandinavian were bidden to choose from this year's American biographies the title of greatest interest to the world. He would perplexedly regard the new lives of Cleveland, Olney, and Robert Bacon. If trained in economics he might pause over the biography of Francis A. Walker. He would cast a glance at the books on Jefferson Davis and Samuel Adams. He would wonder who Caleb Cushing was. In the end he would be likely to point an emphatic finger at Frank B. Copley's "Frederick W. Taylor, Father of Scientific Management."

It is less than twenty years since Taylor, after many struggles, found two plants in Philadelphia willing to develop fully the system which had just been partly tried and rejected at the Bethlehem works. It is less than nine years since he died, with labor vehemently attacking his sytem and the general public quite ignorant of its tremendous import. Taylor will be remembered in Europe as well as America for his discovery of high-speed cutting tools alone, which has more than doubled the output of machine shops throughout the world. But his development of a plan of scientific management and his demonstration of its applicability to manifold human activities entitle him to a place among the few men who have profoundly altered the history of industry. His plan embraces three elements: the scientific selection of the worker, the establishment of the most efficient processes, and the cordial cooperation of management and worker in performing them. He never denied that the mechanism of his plan could be perverted. A selfish management could use it to speed up production without increasing the rewards of labor. But Taylor always insisted that it ceased to be scientific management the moment it was not used to elevate rewards as well as lower labor costs.

Mr. Copley reveals in Taylor a personality of amazing force, originality, and persistency, and, it may be added, of much eccentricity. He was born in Germantown of the mixed Puritan and Quaker ancestry which lies back of so many outstanding American figures. His father was a gentleman of fortune and leisure, a lawyer who never practiced; but the boy at once showed stern strenuosity. At Phillips Exeter he worked so hard to head his class that his eyes weakened and college became impossible. He promptly took a job in a machine shop, and in 1878 became a journeyman machinist. As a common laborer he entered the Midvale plant, and within a few months rose to be gang boss. Promotion soon made him master mechanic, and within six years he was chief engineer. On a working day that began at 6:30 A.M. he never spared himself, and often worked overtime and Sundays. He used to study from 9 P.M. till midnight, and never had more than four or five hours sleep. No work was too dirty, and he once won notice by crawling 100 yards through a slime-choked drain under the mill foundations to remove an obstruction. He never flinched under harsh bosses, who believed that to spare the damn was to spoil the man, and took the roughest treatment from men who threw his plans into the fire and cracked the whip over him. He learned and constantly practiced profanity himself. Ida Tarbell says that he "never seemed more of a gentleman than when he was swearing."

---

[1] Reprinted by permission from *New York Evening Post*, November 26, 1923. The caption is ours.

[2] Author and Editor, New York City.

Above all, Taylor showed from the first his alert inventiveness. Men derided his "monkey mind," which questioned every machine and process. When a boy he had devised a unique sled-stopper and a harness to keep himself from turning on his back in sleep. At Midvale the assertive youngster was constantly making critical suggestions. "Well, they can laugh at Fred Taylor all they please," remarked an associate, "but what I notice is that in the end his ideas are acted on." He improved the design of tools. He built the first steam hammer that did not rapidly batter itself to pieces. This invention was arrived at by a characteristically methodical process—he obtained designs of hammers from all over the world, collected instances in which different parts of various machines had never broken, combined these parts, and added an original design of his own for one part which had always given way. He put up a famous chimney which climbed obliquely towards the sky and then suddenly changed its mind and leaned over in the other direction. Then came his famous metal-cutting investigation and his new cutting steel. Even in trifles he was an innovator. His spoon-handled tennis racket gave his wrist greater dexterity. His forked golf club and unique method of using it made other golfers dumb with amazement, but they had decided merits.

The germ-idea of scientific management was planted in Taylor's mind when at Phillips Exeter he watched the famous mathematician, George F. Wentworth, take time observations to make sure that he was assigning just enough work to occupy the average of his class two hours. He perceived the need for scientific management when as a common laborer at Midvale he had to share in the "soldiering" by the workers, and as a gang boss he had to stop it. The piece-work system had usually failed because it was followed by rate cutting. Taylor had never heard of the pioneer labors of Babbage in England. But in 1881 he began, entirely on his own responsibility, to analyze and time all the separate operations of work in the machine shop; and in 1883 he hired a young man to give his whole attention to this. He found that even shoveling coal could be "scientific." He discovered that the efficiency of a laborer in piling iron pigs could be increased 3.6 times. He learned that workmen's movements could be made efficient, tools and conditions standardized, and superior methods invented. Very importantly, he found that his innovations encountered the angry opposition of men and department heads, and that to introduce them brought on a veritable "hell period" before they succeeded.

Mr. Copley makes an absorbing story of Taylor's gradual development of his system at Midvale until he had perfected a definite technique for all departments and made cost accounting contributory to it; his launching out as the world's first consulting engineer in systematizing shop management, and his tremendous fight at the Bethlehem works. His conflict here with Robert Linderman, the president, and with the host of Linderman's subordinates, who resisted Taylor's revolutionary reorganization, was titanic. Joseph Wharton, the leading owner, flinched at a critical moment, and just as Schwab bought the plant, Taylor was ordered out. Schwab also rejected scientific management. But the men in actual charge of operations found they couldn't get on without it, and it stayed, at first behind Schwab's back, later openly.

Meanwhile it was invincibly making its way elsewhere. The Tabor Company and the Link-Belt Company adopted it. It penetrated into the navy yards and arsenals. Mr. Brandeis' announcement that scientific management would save the railways enormous sums made in 1911 a topic of general discussion. While narrating all this, Mr. Copley gives ample space to the equally fascinating subject of Taylor's character. He never was rough in his attitude to men under him and about him; he cherished a senselessly violent prejudice against Germans, college professors, theologians, and numerous others, and he had no use for labor unions. Yet there was a gentler side to his nature, which is as admirable as his intense devotion to the great principles he was teaching. This excellent biography presents one of the true heroes of American industrial progress.

Taylor a Scientific Revolutionary[1]

By Edward Eyre Hunt[2]

658.
658.92

THE appearance in two volumes of Frank B. Copley's "Life of Frederick Taylor, Father of Scientific Management" is an event. Frederick W. Taylor was one of the great figures of our time, and his published life will help the public to become aware of that fact. His ancestry and boyhood, his work at Midvale in the '80s, his activities as consulting engineer in management, his achievements at Bethlehem in the late '90s, his influence on the American army and navy and his other public services are graphically traced.

The origins of scientific management, better known abroad as the Taylor System, are described in terms which everyone can understand. There was nothing theoretical about Taylor; he was a mechanical engineer, but first he was a shop manager confronted with concrete problems, and his system of management, built at first piecemeal, was the scientific solution of his problems. It was a successful effort to give the machine shop a brain commensurate with its size instead of leaving it, like the prehistoric megatherium, with an elephantine body and a peanut intelligence. Functional foremanship, one of his great discoveries, was a gradual development—what detractors like to call an "accident." His differential wage system was another development. Time study with the use of the stopwatch, which caught the public fancy in 1911, was only one of his management devices. He was the first to bring the scientific spirit completely to bear upon the problems of managing men and materials.

What might be called collateral results of his shop systematizing, such as the great discovery of high-speed steel—a discovery which made possible the cutting of metals at such speed and temperature that the nose of the tool burned a dull red and threw off bright blue chips; his work with Barth on slide rules; his picturesque experiments in growing synthetic golf greens; his methods of removing full-grown trees and plants such as the famous avenue of old box planted in Germantown by du Barry in 1803, or the fifty-year-old wisteria which he transplanted while in full bloom; even his startling inventions of golf clubs, such as his fork-armed putter, filed mashie, and extra long driver, together with his spoon-handled tennis racquet (he was a good golfer and held the National tennis championship one year)—all are given their proper place in the story.

Taylor was a cooperator. His use of the editorial "we" in describing his work was deliberate, for the revolutionary results which he achieved were due in large part to his ability to inspire groups of co-workers, among them such outstanding figures as Barth, Gantt, Hathaway, Thompson, and Cooke.

It is not, I think, a superficial resemblance which Mr. Copley traces between Frederick W. Taylor and that other eminent Philadelphian, Benjamin Franklin. But I felt, as I read his life, a more than passing resemblance to another great American, not in the field of his achievements, but in the force of character which brought them into being; the self-confidence, the strenuous courage, the belief that to do less than one's best is a social crime, the faculty of inspiring others to effort, the prompt and voluble acknowledgment of the achievement of others, the delight in battle for a good cause, and the very human feeling that "he who is not with me is against me"—surely here there is a resemblance to Theodore Roosevelt. And there was something Rooseveltian in the manner of his death. "About half-past four the next morning he was heard to wind his watch. It was an unusual hour, but nothing was thought of it. Not until half an hour later did the nurse enter the room to find that he had died there alone."

In Soviet Russia, in France, in Germany, in Great Britain, in Japan where Barth has just gone, and in engineering circles in America the Taylor System is looked on as one of the most significant developments of modern life.

But Taylor's purpose was not simply to invent novel mechanisms. He was inspired throughout by a high type of social idealism. He was a scientific revolutionary. He worked to bring about a new world, a world in which knowledge shall reign, in which each man and woman shall be trained for his task, in which each shall do his best, and in which each shall be rewarded according to his work, in order that all the powers of men and of nature shall be released for human happiness.

In any American pantheon there ought to be a commemorative tablet to the life and work of Frederick W. Taylor.

---

[1] Reprinted by permission from *The Outlook*, January 23, 1924. The caption is ours.

[2] Secretary, the President's Conference on Unemployment; editor of "Scientific Management Since Taylor."

An Appreciation of a Contemporary[1]

By Fred J. Miller[2]

{ 658.
{ 658.92

ALL who knew "Fred" Taylor well will recognize this biography as a most excellent piece of work. It is clear that the author has had access to abundant material and that he has delved into it thoroughly and conscientiously, with the sole object of presenting a true and lifelike picture of his subject; in no biography that I know of has more complete success been attained.

No one who is in any way or in any degree concerned with knowing what has happened to American industries and how it has happened since Taylor went to the Midvale Steel Works in 1878, can fail to find these volumes absorbingly interesting and extraordinarily informative.

This is not a mere colorless catalog of achievements, great and far-reaching as those achievements were; not alone Taylor himself but many other outstanding men connected with industrial affairs are here presented to view in what to most of us is a new light; some to their high credit and some quite to the contrary. Indeed, the success attained by a number of famous men in industrial affairs is clearly seen to be necessarily attributable to causes other than ability as industrial managers, for of such ability, it is made clear by this record, they had practically none whatever, not only when judged by present-day standards, but by the standards of their day. This is only incidental, however, for this is essentially a life of Fred Taylor, and others are brought into it only as brush strokes needed to complete the picture of that unique, talented, and many-sided character.

Taylor is here shown to have been reared in a refined environment by parents both well and broadly educated. His entry into industry is shown to have been almost purely accidental, though he early exhibited a talent for invention and for systematic ways of doing things.

His first employment was (I feel bound to say, unfortunately) in a place where things were pretty rough, where the only discernible philosophy was, on the one side, to drive, and on the other, to resist that driving; where gross profanity and all that it connotes was thought to be a necessary element in a workshop, as it is said to be in driving mules. Taylor, young and impressionable, not only adopted it but deliberately cultivated it, mainly for shop use, ignoring the plain fact that many of the most successful managers of that day, as of this, never used it nor ever allowed themselves under any circumstances to exhibit any evidences of anger or of serious emotional disturbance.

Most of us have the idea that the Taylor "system" was developed and put in practice from previously-thought-out plans, much as an office building or a factory is built. It is here made plain that the system was developed by a step-by-step process, each step being dimly, if at all, foreseen, but finally perceived to be more or less a necessity to hold the ground attained by preceding steps. Just here Taylor's remarkable persistence and indomitable courage enabled him to go on and on to magnificent accomplishment where others, perhaps equally well equipped in other respects, would have been discouraged and quit.

He began by trying to get men working in a machine shop to do more work; found their knowledge exceeded his own; built up his knowledge of the work; found he could not go very far because the management was faulty or practically nonexistent; started in and, step by step, developed a science of management; found the accounting, especially the cost accounting, blocked his way by its inadequacy and stupidity; learned accounting and developed a real system of industrial accountancy.

He started to climb a high and difficult mountain; climbed one step at a time, never thinking of giving up or even resting himself so long as his strength lasted. The top of that mountain is not yet clearly visible—it will probably be difficult to determine when, if ever, it is quite reached—but to Taylor belongs the credit of showing that it can be climbed and how it can be climbed. There were those who appreciated and helped him—William Sellers, James Mapes Dodge, Henry R. Towne—all men of outstanding achievements, partly because they could understand the work of others and were above being jealous or envious of it. Besides these outstanding men in civil life, General Crozier, Chief, Ordnance Department of the U. S. Army, and Admiral Casper F. Goodrich, of the Navy, did all that was humanly possible to secure, for their respective departments, the benefits of the new system, and Taylor gave his services to them in the public interest, I understand, without charge.

---

[1] Reprinted by permission from *Mechanical Engineering*, February, 1925. The caption is ours.

[2] Member of Pennsylvania Public Service Commission; Past-President, A. S. M. E.

Whatever Taylor did he literally did with all his might. Whatever seemed to stand in his way even for a minute he attacked, usually with a vigor and vehemence that made him, unnecessarily, many enemies, not alone among workingmen but among employers as well.

But there was no guile in him; whatever he did he believed in with all his soul, and whatever he believed in he did with the same absorbing devotion; utterly unable apparently to understand the world's capacity for passive and active resistance to innovators.

Workingmen, generally, in and out of unions misunderstood him, and the vast majority of employers resented his unsparing criticisms of their management. To many of them scientific management and the Taylor System are still anathema. No one can say in what degree this is due to the bludgeon methods of Taylor and some of his disciples, but much of it is undoubtedly. The biographer has clearly recognized this and revealed it.

Then, too, a little more familiarity with fundamental economics would have spared this heroic personage a good deal of effective opposition. He was wrong as to some of the results he anticipated from his work, and failed to realize the fact that a very large proportion of workingmen these days do far more reading of journals that are independent of "counting-room influence" than the journals generally read by employers; and devote more attention to the study and discussion of fundamental economic principles; principles which it is a very serious mistake to disregard, because such disregard is responsible for most of our industrial and business difficulties.

An important share of Taylor's difficulties at Bethlehem are shown to have arisen from the fact that a number of directors of the company were landlords in Bethlehem and imagined their personal interests as landlords were threatened by Taylor's efforts to get given quantities of work done by fewer workers. They actually thought Taylor was going to depopulate Bethlehem and make rent payers scarce. Yet when a hard-headed, successful millionaire manufacturer wrote Taylor urging a solvent for that difficulty, Taylor spurned him, and said quizzically, "There is a man even crazier than I am." Repeatedly Taylor avowed his belief that his system would, of itself, solve all industrial and accompanying social problems. Whereas the workers knew by hard experience that, for example, the introduction of steam power and labor-saving machinery—increasing the productive power of workers far more than any system of management could—had brought them only that which they had fought for through unions and otherwise; as witness the struggle to abolish the sweat shops long after the introduction of power-driven sewing machines and the appearance of Hood's "Song of the Shirt."

To decry or oppose labor-saving machinery or improved systems of industrial and business management is of course futile and foolish, but not for the reasons Taylor thought it was; and hence much of what he said about the social effects of his work was based upon a wrong premise, did not ring true, and workmen in general more or less clearly perceived this. It did not square with their experience, nor with the history of "the labor movement" reaching far back to the days of ancient guilds and beyond. This tended to confirm their suspicion that Taylor management was simply another scheme to make workers turn out more work for the same or even less wages. They misunderstood and were not aware that Taylor believed and intended that his system would and should benefit the workers as well as employers. Out of this misunderstanding grew Taylor's reiterated and bitter denunciation of workmen for general "soldiering," a charge which had absolutely only one effect, that effect being increased and more effective opposition to the introduction of the Taylor System. Taylor was made to feel very keenly mankind's intolerant and shortsighted attitude toward those who would disturb the established order; but this antagonism was increased by such things, for example, as his emphatic condemnation of tool makers as "humbugs and frauds," utterly failing apparently to appreciate the fact that thorough study of the best possible design of special tools and putting into them the best allowable or attainable workmanship, had been and still is the most important single factor in establishing and maintaining our preeminence in low-cost interchangeable manufacture of such things as sewing machines, watches, small arms, typewriters, and innumerable others.

The episode of high-speed steel is treated in an interesting way, but the fact is not brought out that

Taylor, before applying for a patent, addressed letters of inquiry to all the leading steel makers here and abroad, asking them if they made, or knew of anyone who made, a steel which could be heated to a white heat—"a dripping heat"—without injury to its cutting qualities.

They all said they knew of no such steel, and yet, when the validity of the Taylor-White patent on this steel was finally tested in the courts, it was invalidated on the ground that such steels had been made and used for years—a striking instance of a court's decision entirely at variance with common knowledge and informed conviction. Taylor and Maunsel White will always be credited as the real inventors of high-speed steel, as they really were, the courts notwithstanding.

There are those who think that Taylor and his work are more highly esteemed abroad than here. If that is true, may it not be because abroad they judge by the carefully considered writings of Frederick W. Taylor, whereas here what he wrote is read with stuff between the lines composed largely of violent methods and violent denunciations.

But these things will pass away. The public will forget them or will clearly distinguish between them and the real constructive work; much as Taylor's biographer has done with such consummate skill and good judgment.

For perfectly good reasons, no doubt, the full story of what Taylor did for The American Society of Mechanical Engineers during his term as its president is not revealed in these volumes nor elsewhere. That it was a critical period in the career of the Society had been perceived by others and some remedial steps had been taken, but Taylor threw himself whole-heartedly into the work, allowed nothing to stand in his way, and brought about, mainly by his own efforts, though not without assistance from others, a complete reformation in the Society's methods of administration, securing from the Council the needed authority for a small committee, of which he was chairman, to make the necessary changes in personnel.

The full story would be of interest chiefly, of course, to the Society's membership, and some day perhaps it ought to be revealed in justice to Taylor and to certain of his associates and supporters of that time, most of whom, like him, who took the leading part, have disappeared from the scene of action.

Taylor the Cooperationist[1]

By Richard A. Feiss[2]

{ 658.
{ 658.92

THE situation that existed when Taylor entered industry consisted of the minimum of cooperation and the maximum of antagonism. In the employer-employee relationship that had grown up, there were only a few outstanding instances in which it was realized that cooperative relationship was fundamental to the entire set-up of industry. Both employer and employee possessed false points of view which precluded any basis for real cooperation and which assumed that their positions in industry were entirely antagonistic.

Taylor clearly saw that the salvation of industry involved the greatest possible increase in production at the lowest possible costs and a larger "prosperity" for both employer and employee. Such results could be obtained only by a realization on the part of both that their interests were common to those of industry itself. This meant that "friendly cooperation" was paramount. Taylor often said scientific management always involved a mental revolution of the employer and employee toward their work and toward each other.

Taylor realized that this revolution would not come about by abstract preaching. It could be brought about only by a slow process—by developing a technique of organization and methods based on sound principles and philosophy and applied in a scientific way to the specific problems in the plant. Everything Taylor did was to this end.

The revolution in the minds of management begins with the realization on the part of management that its function consists of full responsibility for both planning and executing in detail everything necessary for accomplishment. This puts upon management the specific responsibility of planning both what to do and how to do it. The duties of management are analyzed and the functions inherent in managing are set up. This results in functionalized management. Functionalized management is nothing more than specialization in management with the same benefits which are brought about by specialization in any other field.

Management properly has to devote itself as part of its function of leadership to the task of bringing about a revolution in the minds of the men in order to enlist their cooperation. The antagonism which to a great extent still exists and which is based chiefly upon the conflict in interest in the share of the results of industry had to be overcome. The theory that all the interests of the employer and employee are opposed was almost universally held during Taylor's early years. He recognized that under the conditions that had grown up in industry this feeling not only existed, but that there was also cause for it so far as the employee was concerned. The lack of a basis of cooperation necessary to industry itself was a thing that to Taylor's mind was wrong and had to be overcome.

---

[1] Reprinted by permission from *Harvard Business Review*, October, 1924. Abridged. The caption is ours.

[2] Manager of Manufacturing, The Joseph & Feiss Company; Past-President the Taylor Society.

The purpose of industry is to create wealth in the form of commodities and services for the use and benefit of the community. Those who take part in the creation of these commodities and services naturally look to industry for an immediate benefit. It follows that their incentive shall be a participation in the rewards of industry in accordance with their individual contribution. This principle is basic to the entire Taylor philosophy. From this point of view, the interests of both employer and employee are alike provided for in that as individuals each profits in accordance with his contribution.

Towards this end Taylor devoted himself to analyzing every activity and every responsibility in the business of production with a view to establishing an accurately determined measure and method for every kind of performance. It was this characteristic of thoroughness that not only made his contribution possible but made it inevitable that whatever came within the scope of his activity or interest he analyzed in detail in a thoroughly scientific manner. Because he was of an essentially practical and constructive mind, his analysis resulted not only in a synthesis as to which was the one best way in any given instance, but also in a formula or a generalization which embodied the correct principle.

The importance of developing a comprehensive and coordinated technique which involves not only the determination of method but also the determination of reasonable time required for performance is apparent. Such a technique permits of the establishing of a method for rewarding the individual according to the quality and quantity of his accomplishment. The development of some suitable form of payment, which is dependent upon performance and which is substantially greater for accomplishment in accordance with definitely set standards, is material if not essential in making effective the mutuality of interest that is inherent in and necessary for the proper conduct of business. When scientifically worked out and developed, the results effect that revolution in the minds of the men which replaces antagonism with cooperation.

Taylor's work has too often been viewed as a set system. He himself laid stress upon the fact that exact methods would and should be improved and developed, and that in all instances they should be modified to apply to a particular situation. But the principles that Taylor first enunciated as fundamental to industry must be applied 100 per cent in order to get results. In application the analysis necessary will reveal that the problems of management are of a type common to all organizations.

Time study, routing, and other functions of planning are not in themselves scientific management, but are part of the technique of scientific management. It is with such aids that the science involved in the performance of any task is discovered and perpetuated for the benefit of the industry. Significant as was the work of Taylor and his associates in the discovery of high-speed steel and the ultimate publication of his 25 years of experimentation in the art of cutting metals, its real and impressive significance is apparent only when it is realized that its purpose was merely the discovery of the science involved in a group of machine shop operations as a logical incident in the application of scientific management methods.

The value of Taylor's work consisted not only in the expounding of the correct principles of organization and management but also in the practical illustration of them by application to the actual problems of management. In fact, the great value of Taylor's work is that the principles are but generalizations derived from shop experiments and practices. He demonstrated that the accomplishment of even the most ordinary kind of work involves a science, and the coordination of all the activities of an organization involves an art. As a result, management has become one of the great professions involving both science as applied to the handling of all materials and methods, and art as applied to the handling of all its human relations.

While the term "scientific management" can as yet be applied to the management of only a few organizations, the influence of Taylor's work, his sound principles and comprehensive philosophy extend far beyond these limits. An increasing number of leaders, not only in industry but also in other communal activities, are influenced in their thinking and in their actions by the Taylor philosophy. So much of this influence is subconscious that there is at the present time no possibility of an adequate appraisal of its extent.

One who is interested in industry and the solution of its problems, one who is interested in the life and accomplishment of a practical man with a big vision cannot afford not to read this life of Frederick W. Taylor.

A Promoter of Harmony[1]

By Scudder Klyce[2]

658.
658.92

THIS life of Taylor by Copley does two things at the same time. It describes the activities and character of an engineer who almost surely will be ranked by coming generations as one of the greatest men of the world. And it shows how Taylor worked out the principles and methods of handling men, and just what those are and how they work.

It is an astonishingly honest, and hence interesting, life story of a most unusual and vivid man. Copley frankly acknowledges to begin with that he is enthusiastic over the soundness and greatness both of Taylor's personal character and of his work. The result is a real biography of a real man—a hard hitting man we can't help but respect and admire. Miss Ida Tarbell is quoted as saying, "Mr. Taylor never seemed to me more of a gentleman than when he was swearing."

Both our Army and Navy are primarily interested, as was Taylor, in finding out how best to handle men and to handle machinery—and, usually, how best to handle them together. So it was natural, almost inevitable, that he should have had extensive dealings and friendships with both Services. And those Service matters are given in considerable detail.

One long chapter is given to Taylor's connection with the Navy, and one to the Army. Most of the navy chapter gives Taylor's relations to Admiral Goodrich's reorganization of the New York Yard, and the subsequent extension of that as the "Newberry plan," and then the opposing "Meyer plan." The army chapter describe's General Crozier's introduction of scientific management into the arsenals, and the objections made by some labor leaders. The inside facts and reasons controlling those Service questions are given, Taylor being at the bottom of them. He also dealt with education extensively, advocating for all colleges the West Point and Annapolis discipline, showing why.

Taylor's principles and methods of handling men primarily aimed at what he called the "promotion of harmony," and are based on justice and common sense which is the opposite of coddling and slackness. There is no space here even to summarize those principles which Taylor worked out with such extraordinary ability, and which Copley presents so entertainingly. It is the most intelligible and directly applicable book on handling men the present reviewer has read.

Copley is a trained and successful popular writer, and his long study of Taylor has given him much of Taylor's pungent and vivid speech. So this life he writes of Mr. Taylor is more interesting than a novel, entirely apart from the fact that it deals much with our own friends and affairs, and is in a high degree professionally useful to us as a treatise on handling men.

Scientist of Work[1]

By H. S. Person[2]

658.
658.92

ECONOMISTS and engineers are in accord that this is a significant portrayal and interpretation of an epoch of major importance in American industrial history (1880-1915); a panorama of the growth of a philosophy of which Taylor was the leading artisan, which has so seized the world as to have led to the holding this year of an international management congress dominated by the concept of "scientific management"; and that as an historical analysis and exposition of Taylor principles and practices of management, it makes these more understandable than do the collective writings of Taylor himself. There is general agreement also that Taylor was a scientist of the highest order.

What started the young foreman along the line of investigation and experiment which eventually resulted in epoch-making discoveries in cutting metals, in the "Taylor System" and scientific management, was a desire to find a factual basis for better relations between employer and employee. A strong social sense, an inherited Puritan-Quaker tradition essentially religious in nature (although he could not identify himself with any church), and a democratic respect for every individual, no matter how humble, governed the utilization of his scientific ability, and made betterment of industrial relations the dominating motive throughout his life.

---

[1] Reprinted by permission from *U. S. Naval Institute Proceedings,* July, 1924. The caption is ours.

[2] Author of "Universe," Winchester, Mass.

[1] Reprinted by permission from *Survey-Graphic,* December, 1924.

[2] Managing Director, the Taylor Society, New York City.

Taylor's abomination of "autocratic authority" affords a cue to an understanding of his controversies with employers and with organized labor. Although it was his controversy with organized labor which received the greater publicity, he was consistent, in that criticism of employers was equally vehement and on the same grounds. To him autocratic authority was the authority of mere ownership, or of organized power, or of guess, whim or prejudice. He believed that both ownership and organized labor were in conduct exponents of such autocracy. His attitude was governed by the profound conviction that greater productivity, shared by all, is the condition precedent to a higher standard of living, and that "laws and the control of laws" of industrial action, in general and in detail, which would lead to greater productivity, could be discovered if owners, managers and workers would consent to the discovery of them, and that such consent would mean a getting-together which would resolve most of the problems resulting from common misunderstanding. Neither owners, managers nor unions would in his day listen to this suggestion.

Being both fearless and intensely serious, he on the one hand condemned "a hog employer or an employer careless of his workmen's rights," and on the other hand, with less violence of speech but with equal intensity of feeling, condemned labor organizations which "as at present constituted stand for war, for enmity." "The labor unions—particularly the trade unions of England—have rendered a great service, not only to their members, but to the world . . . ." "There is no reason why labor unions should not be so constituted as to be of great help to both employers and men." "You realize of course that I am not opposed to labor unions. Their proper field as they now exist is, I feel, outside of scientific management . . . . I can conceive of a union that would be most helpful to scientific management, but I have not yet seen this union." One wishes he could have lived to witness certain recent developments in various clothing markets and on a certain railroad—evidences of a new mental attitude on the part of some owners, managers and unions, resembling that of Taylor himself and brought about in no small part by his influence on industrial thinking.

"Take Nothing for Granted"[1]

By Edward P. Leonard[2]

{ 658.
658.92

THE improvement of business methods was a passion with Frederick W. Taylor. That is the chief impression left by his recently published biography. Nothing was too small, nothing too vast for his painstaking attention.

He demonstrated that science—the scientific method, rather—could be profitably applied to the very practical details of business. And his shop experiments were models of exactness. In his metal-cutting investigation, the high spot of which was his discovery of the high-speed drill, Taylor made 40,000 experiments. Two similar investigations have been made, one in 1901 by a committee of Verein Deutscher Ingenieur (the German Society of Industrial Engineers), and the other in Manchester, England, in 1903-04 by eight manufacturing firms acting jointly with the Manchester Association of Engineers and the Manchester Municipal School of Technology. Although the English experiments were more thorough than the German, they did not begin to approach in exhaustiveness the ones that Taylor undertook singlehanded. The English limited themselves to 200 experiments.

Small wonder that the distinguished Frenchman, Henri LeChatelier, member of the Academy, professor of chemistry in the Sorbonne, recipient of the Bessemer medal, father of exact high temperature measurements, and director of *Revue de Métallurgie,* should be somewhat chagrined to find the experiments of Taylor conducted in the everyday practicalities of the shop more thoroughly scientific than those of his own laboratory. "I was somewhat ashamed to find the science of a practical man infinitely more developed than my own," he wrote Taylor. And this from that practical man of business, Henry R. Towne, chairman of the board, Yale and Towne Manufacturing Company: "Mr. Taylor was the first to perceive that in this field (industry and commerce), as in the physical sciences, the

---

[1] Reprinted by permission from *System, The Magazine of Business,* May, 1924.

[2] Associate Editor, *System, The Magazine of Business.*

Baconian system could be applied, that a practical science could be created by following the three principles of that system, viz., the correct and complete observation of facts, the intelligent and unbiased analysis of such facts, and the formulating of laws by deduction from the results so reached . . ."

The results of all this was a new science—that of scientific management. Quite properly, Taylor is called its father. . . .

The ideas of this new science, under any conditions, could scarcely be realized in a day. Taylor spent a lifetime in devising methods by which they could be made into realities. The growth of Taylor's ideas along these lines is apparent throughout his biography.

Thus, the biography is an account of the growth and genesis of scientific management as well as a life of Taylor . . . . It is interesting to follow the step-by-step growth of the Taylor System and to witness the development of the "scientific" methods which are quite usual today—time studies, written instructions, standardization of tools and their care, the planning department, functional foremanship, and so on.

To all these matters, Taylor applied the scientific method. For everything there had to be a standard. Unlike "The Century Dictionary," which defines a standard as, among other things, "a criterion established by custom, public opinion, or general consent," Taylor insisted that a standard was a criterion or model established as a result of scientific investigation.

The work of Taylor along the lines of scientific investigation as applied to industry is too well known for extended comment. His celebrated metal cutting experiments have taken care of that. The Taylor Society, moreover, has enlarged and extended the scope of the Taylor principles of management and in this way has made them more universal. It is to a field in which his work is less well known that the universal applicability of his methods is revealed most startlingly.

In 1901 Taylor purchased some 11 acres of property in the extreme northwest limit of the city of Philadelphia. By this time he had left the Bethlehem Steel Works and had decided to devote the rest of his life, "without pay," to the promotion of scientific management. It was his intention to make of his property, Boxly as it later came to be called, his permanent home.

These were some of the unusual features of his home:

> The windows of his living and dining rooms were seven feet high by nine feet wide; the frame enclosing the huge sheet of glass was hung and swung on ball-bearing pivots placed at the sides. Each window had a shutter operated by a valve; you raised a trap in the floor, turned a valve, and the shutter would rise.
>
> For the conservatory, which was circular in shape, he designed a moving platform operated on a circular track, so that the man arranging and caring for the flowers could stand above them and pull himself around. For each of the fireplaces in the main hall, the living room, and the dining room, he designed a wood box, the bottom of which was the floor of an elevator ascending from the cellar, and thus overcame the need of carrying wood through the house. Each fireplace, besides having a chute for ashes, had a screen which dropped down from the chimney. Above the eaves of the house was placed a cooling chamber with pipes leading to the furnaces and down through other parts of the house to give ventilation through registers." [Volume I, page 190.]

It was to his garden and grounds, however, that Taylor turned his principal attention. Due to the way in which the previous owner had laid out the grounds he was confronted with a particularly difficult problem. It was not at all as he wanted. Consequently, it had to be changed. In the process, Taylor devised a method, hitherto unknown, by means of which growing things, even large trees and delicate flowers, may be transplanted in a way which leaves the most minute root fibers undisturbed.

His enthusiasm for golf led to Taylor's famous grass-growing experiments. He designed a putting green 50 feet by 40 feet and it was laid out in the garden at the front of the house . . . His green, he decided, must be the "best possible green," so he consulted the best grass experts and for three years while using a "good rich garden soil," followed their methods.

Under these methods, however, the "best possible green" did not materialize, "so, of course, he set out to get it."

> As is frequently the case, what at first started with a few simple experiments opened out finally into quite an extensive investigation, covering many elements, the relative importance of which it would have been difficult for anyone to foresee at the start. [Volume II, page 205.]

The extent of these experiments may be appreciated when it is realized that they were carried on for a period of 8 years, or from 1907 until the time of his death in 1915, and that Robert Bender, expert gardener, who was actively in charge of the experiments, had for his helpers a force that from time to time ranged between 10 and 30.

Experiments which were started in a somewhat desultory way soon made Taylor realize that what he wanted to discover was the particular variety of grass which would produce the finest and best surface for a putting green, and then to develop an artificial soil especially suited to growing this grass. "Our object," said Taylor, "became to suit the soil to the grass, not the grass to the soil."

To make his grass-growing experiments yield results, it was necessary, as it had been in the shops, to resort to his principle of standardization. That is, he had to find a standard grass and a standard soil in which to grow it. In all, there were 23 objects which Taylor intended to discover; among others, there were: how to germinate seeds, the proper number of spears per square inch which should be germinated in order to develop grass quickly, the kind of soil in which old roots thrive best, how to promote rapid deep rooting, and the most favorable time of year for planting seed. Regarding these experiments, he wrote:

> One of the first principles governing scientific investigation is that each experiment shall involve only one single change or innovation. And this simple rule has been closely followed by us, although it has, of course, called for a large number of experiments. [Volume II, page 208.]

The care with which these experiments were made is well brought out by a statement of H. Van du Zee, civil engineer, who assisted Taylor at the time.

> Every material had to be tested to show its physical characteristics, much in the way sand is tested for use in concrete, and filtration work. Nothing was taken for granted about these materials; positive knowledge was obtained as to the size of their particles (that is, their air spaces) and their water-lifting capacity . . . .
>
> It was impossible to avoid the feeling that, in carrying on these extensive experiments, Dr. Taylor took joy in putting shop management into the work. There was the precise classification of materials, precisely measured proportions of the various materials that entered into the synthetic soils, precise percentage of water to be supplied, and so on. It seemed as if Dr. Taylor had in mind a routing plan for the roots and for the water. In arranging soils of different kinds in layers at various levels, he made provision for the young roots, and maturing roots, and the fully-matured roots. [Volume I, pages 210-211.]

As for the results of these experiments, suffice it to say that Taylor got what he wanted: "the best possible green."

All the while these experiments were going on, Taylor was carrying on his missionary work of espousing the cause of scientific management. Boxly became the Mecca to which the Taylorites made their pilgrimage.

Everywhere he encountered opposition. On the part of management it was, "what is the use?"; on the part of labor, "he's trying to make machines of us."

It is interesting to note that Taylor himself aroused little antagonism among the men in the shops where he worked. This, he explained, was because he made them realize what he was trying to do. It was simply a case, he explained, of changing the mental attitude of the workmen. He made them see that "what couldn't be done" could be done. There was the notable instance—too well known to touch on at length—for instance, of "systematizing Schmidt" in which he convinced the latter that instead of loading only 12½ tons of pig iron, as was customarily considered a day's work, it was possible for one man—"a high-priced man"—to load 47 tons a day. Schmidt, he insisted, was such a man, and, convinced, Schmidt went about to show that it could be done.

For every man, Taylor had a different method. He was an unerring judge of human nature and he seemed to sense by instinct which method would work best with different individuals.

> One of his favorite methods as a manager was this. He would send for a man and say: "I've been watching you." And then, while the man was wondering what he had done, he would add: "'Yes, I've been watching you, and I've discovered you are the kind of man who works just as well when the boss isn't around as when he is. Just for that, I'm going to raise your pay. Now, damn you, keep your mouth shut." [Volume I, page 179.]

Like John H. Patterson, he was a great believer in teaching through the eyes.

> He became a great believer in object lessons, and he always was in a hurry to set up those object lessons that would demonstrate to his men the benefit to them of his methods. In the meantime, he explained to them as best he could; but there can be no possible doubt whatever if he had relied solely on explanation, he, a pale, gibbering ghost, would have been down there at Midvale explaining yet." [Volume I, page 174.]

At Midvale, where he started his career, he started his "fearsome fining system." One man's fines kept doubling until they finally amounted to $64. Then he finally admitted that the breakage for which he was being fined was deliberate, and that he had